A Picture Book of Best Practices for Subsistence Farmers: Latin American version

August 2016

Manish N. Raizada, Ph.D.
University of Guelph

Illustrations by Lisa Smith
University of Guelph

Global Affairs Canada
Affaires mondiales Canada
IDRC International Development Research Centre
CRDI Centre de recherches pour le développement international

This book was made possible through generous funding from the Canadian International Food Security Research Fund (CIFSRF) from the International Development Research Centre (IDRC, Ottawa) and Global Affairs Canada. We thank our collaborators at LI-BIRD and Anamolbiu in Nepal and at the Canadian Mennonite University.

About the Author

Manish N. Raizada received his B.Sc. from the University of Western Ontario (Genetics) and Ph.D. from Stanford University (Plant Molecular Genetics). He held fellowship positions at The International Maize and Wheat Improvement Centre (CIMMYT) in Mexico City and at the California Institute of Technology. He is currently a professor in the Department of Plant Agriculture at the University of Guelph, Canada. Dr. Raizada is Founder of SAKGlobal (SAKs, Sustainable Agriculture Kits), an effort to bring inexpensive technologies to the world's 1 billion subsistence farmers. SAK kits are based on the principles of sustainable, ecological agriculture.

Manish can be contacted by email at raizada@uoguelph.ca

About the Illustrator

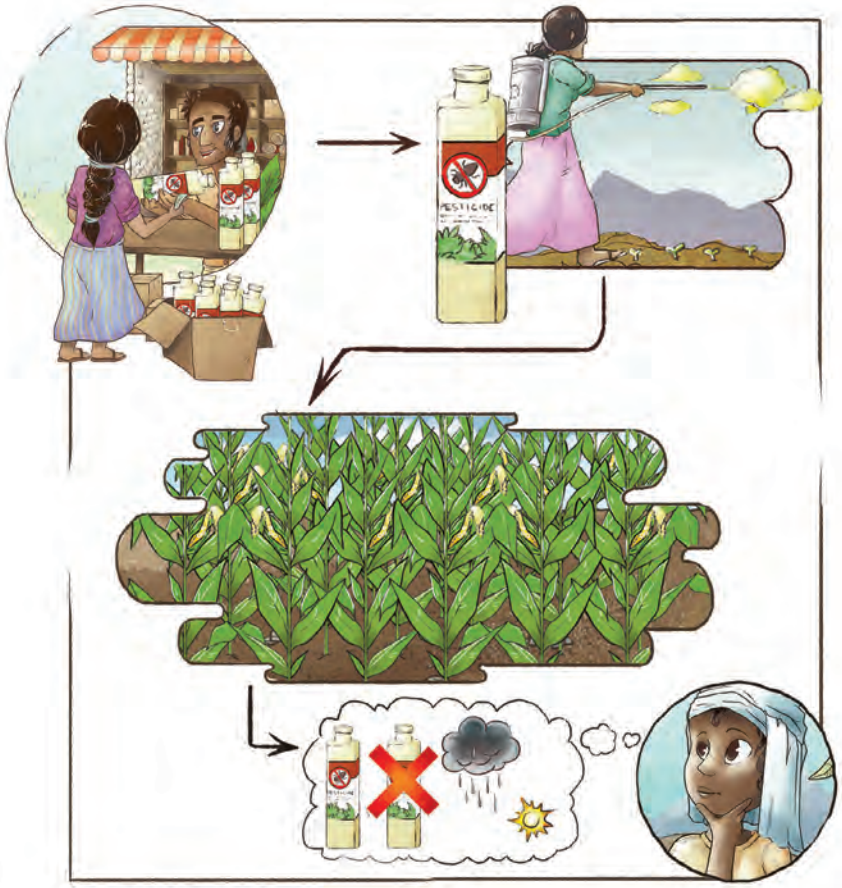
Lisa J. Smith graduated from the Graphic Design Diploma program at Conestoga College in Kitchener, Ontario, Canada in 2014, with her main focus in illustration. In early 2015, Lisa was selected as part of a national competition onto the SAKGlobal team as the illustrator for the picture book along with other illustrated materials. She has created illustrations related to microbiology, genetics, botany, agriculture and international development for scientific journals and presentations during her time with the University of Guelph.

Lisa can be contacted by email at smithjaylisa@gmail.com

Chapter 1: **Scientific Method**

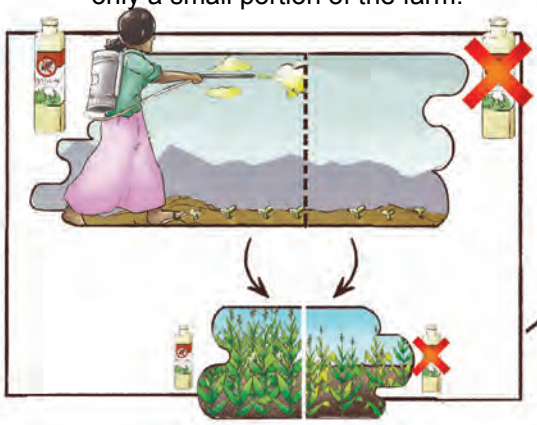
Lesson: Before adopting any new product (e.g. pesticide) or practice, it is important to test it on a small plot using a scientific method.

1. Traditional practice: Purchase seed or product,such as pesticide, then apply onto entire plot.

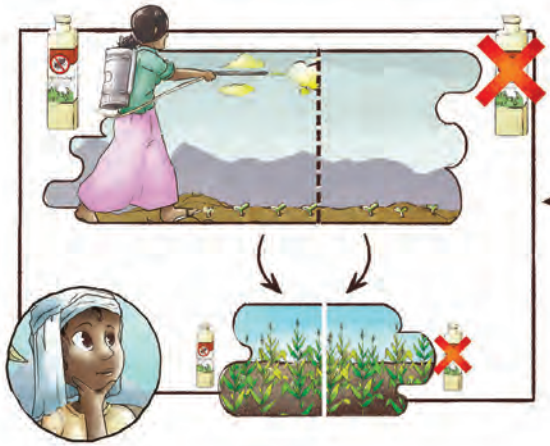


2. The field may show improvement, but the improvement may not be due to the new seed or product, but instead due to other factors. A scientific method can help to evaluate the effectiveness of a new seed or product, to determine whether or not it should be re-purchased.

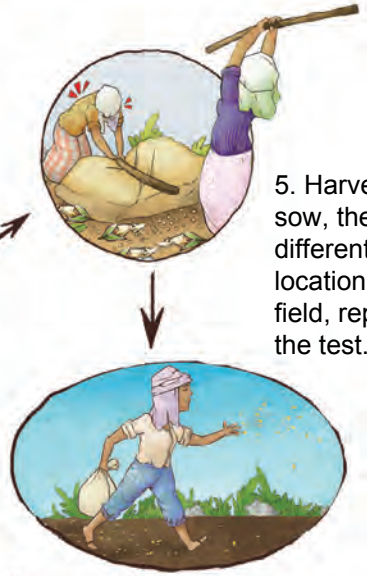
3. Improved practice: Apply the new seed or practice on only half of the plot, keeping the other side with the traditional seed or practice. Conduct the test using only a small portion of the farm.



4. Evaluate both half plots.



5. Harvest, sow, then at a different location in the field, repeat the test.

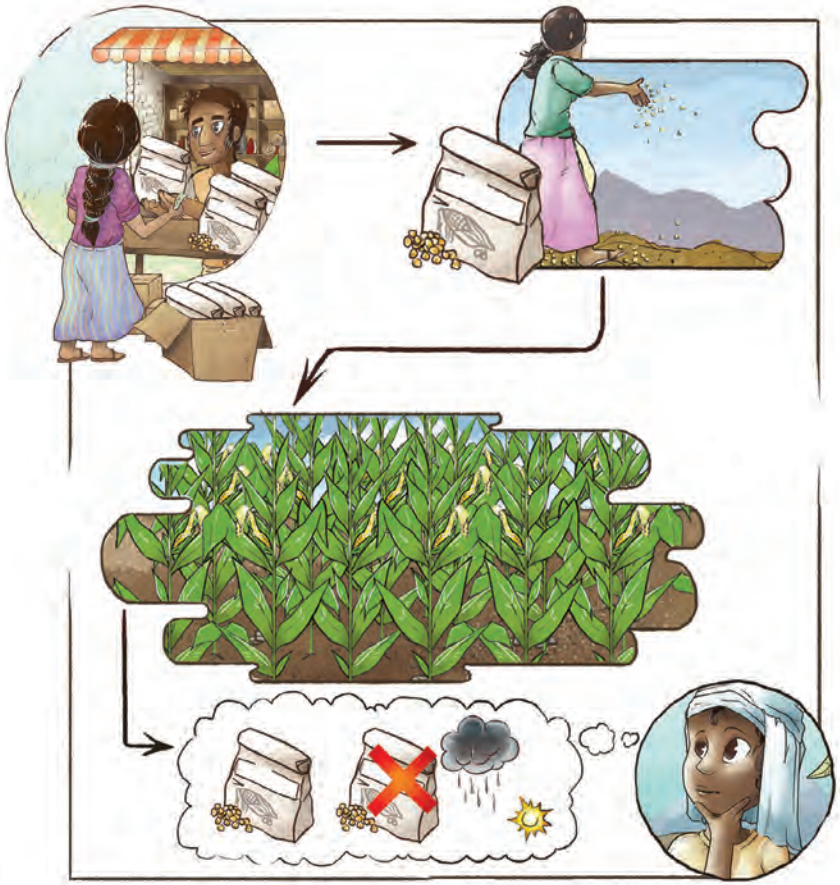


6. Evaluate both half plots (second trial). If the new seed or product resulted in benefits in both years, then it is beneficial.

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

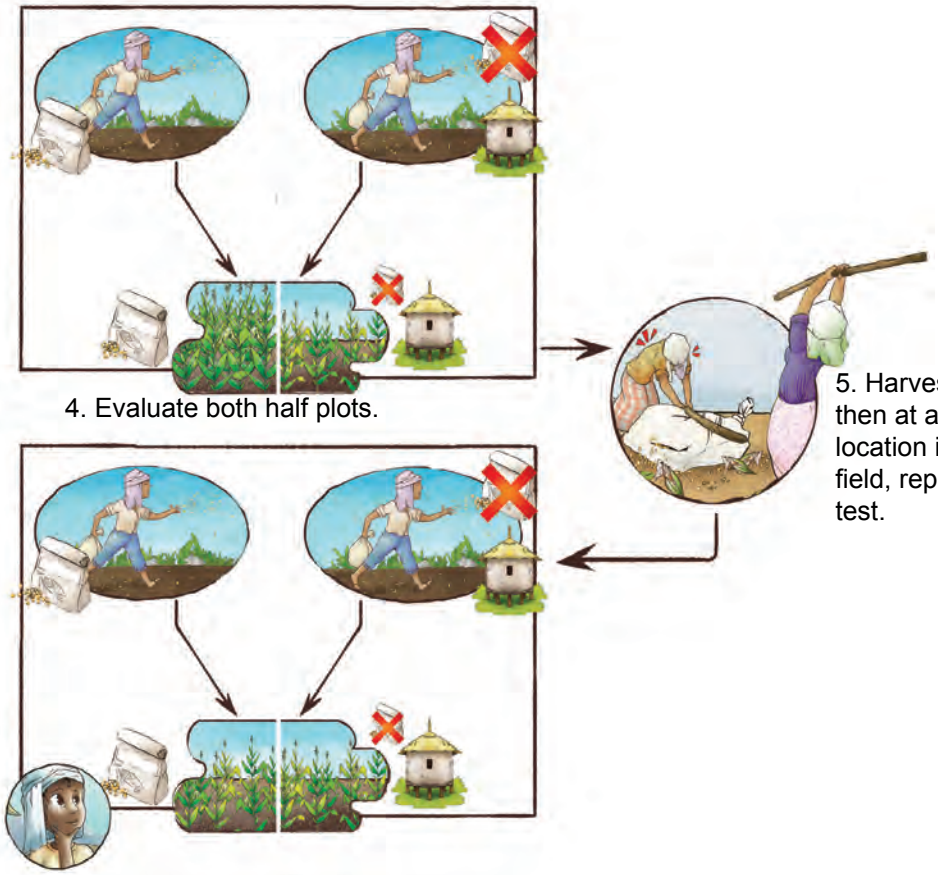
Lesson: Before adopting any new product (e.g. pesticide) or practice, it is important to test it on a small plot using a scientific method.

1. Traditional practice: Purchase seed or product,such as pesticide, then apply onto entire plot.



2. The field may show improvement, but the improvement may not be due to the new seed or product, but instead due to other factors. A scientific method can help to evaluate the effectiveness of a new seed or product, to determine whether or not it should be re-purchased.

3. Improved practice: Apply the new seed or practice on only half of the plot, keeping the other side with the traditional seed or practice. Conduct the test using only a small portion of the farm.



4. Evaluate both half plots.

5. Harvest, sow, then at a different location in the field, repeat the test.

6. Evaluate both half plots (second trial). If the new seed or product resulted in benefits in both years, then it is beneficial.

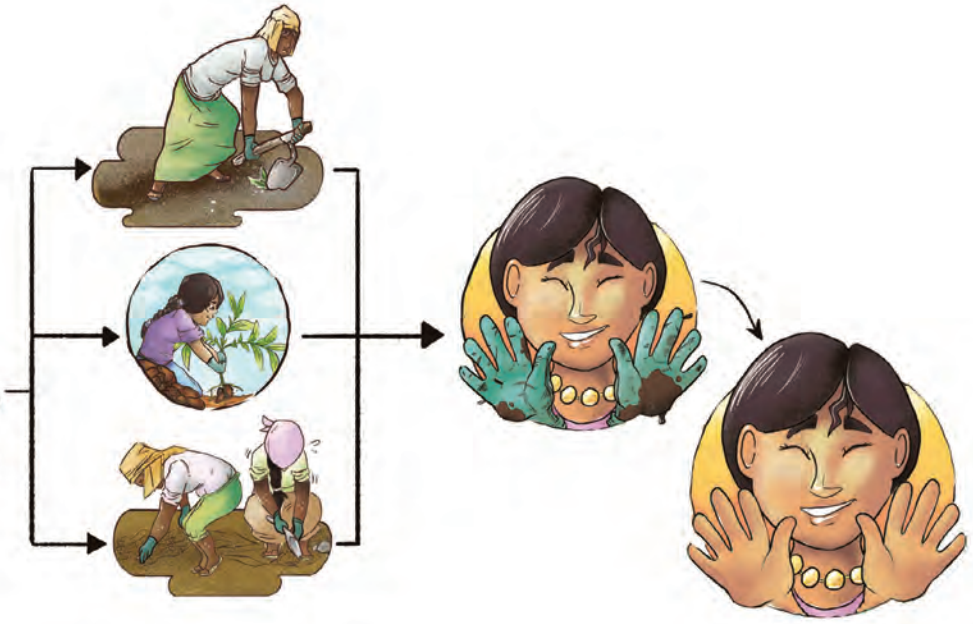
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Chapter 2: **Land Preparation & Sowing**

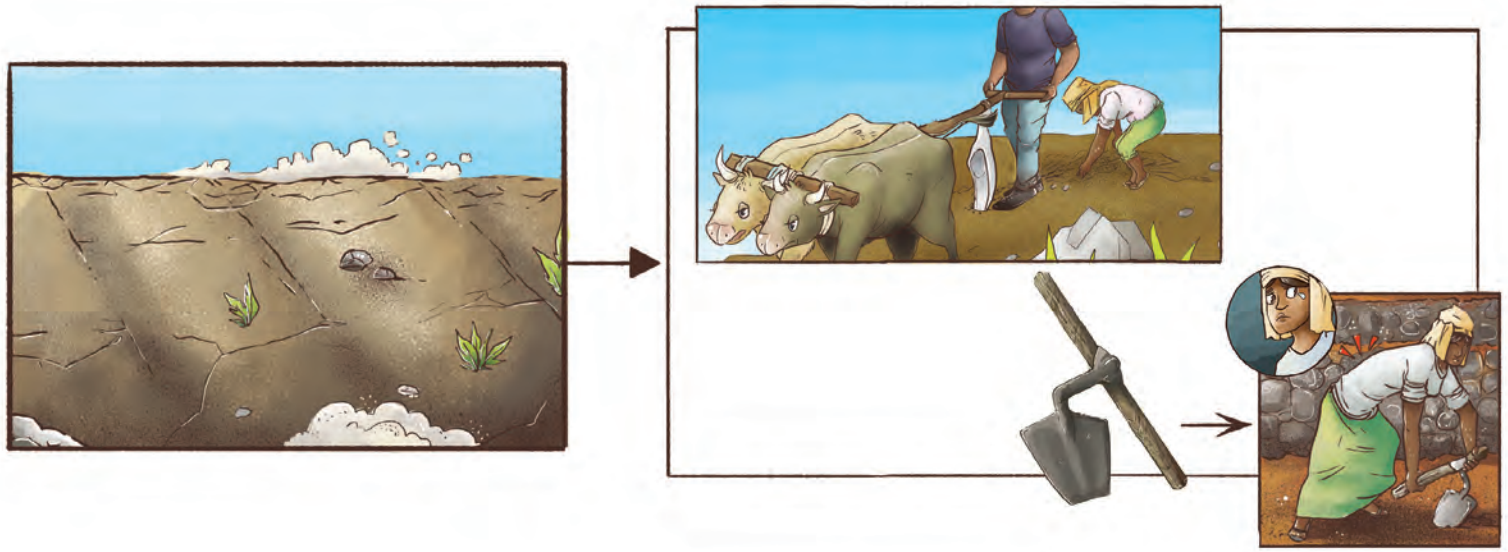
Lesson: Gloves reduce pain and damage to hands.

1. Traditional practice

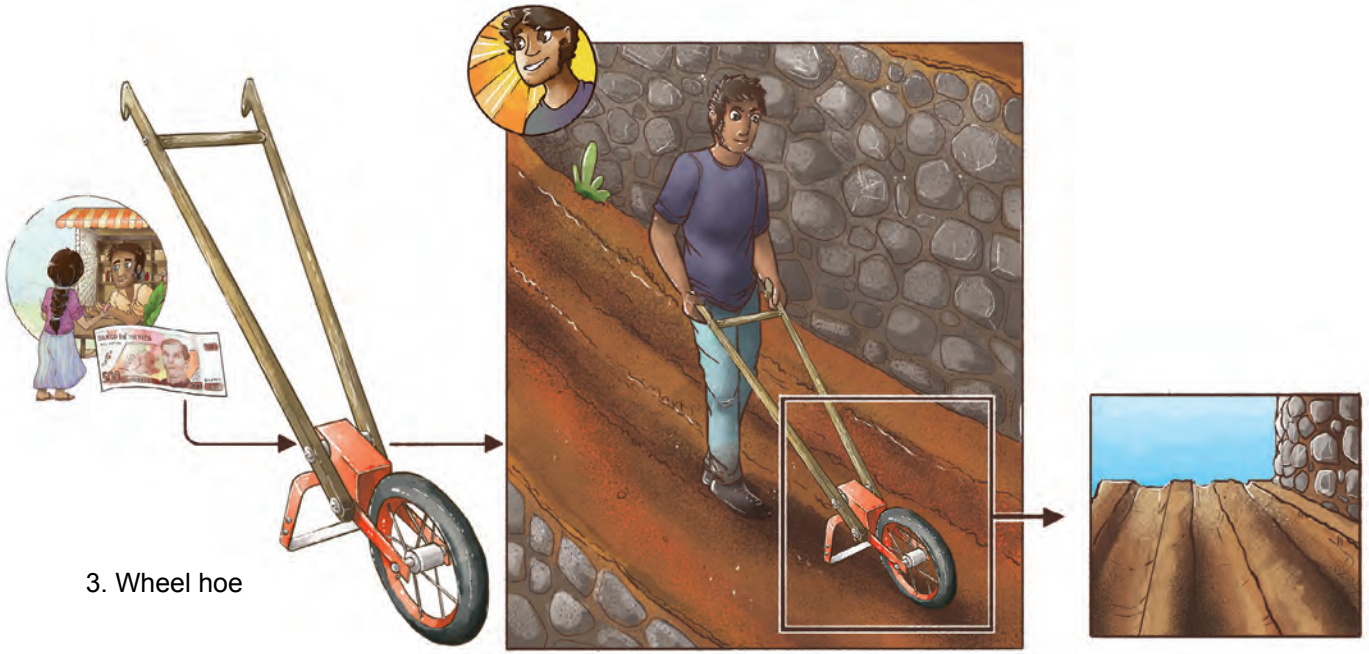
2. New method:
Gloves protect hands.
Request from local vendors.



Lesson: New tools to prepare field



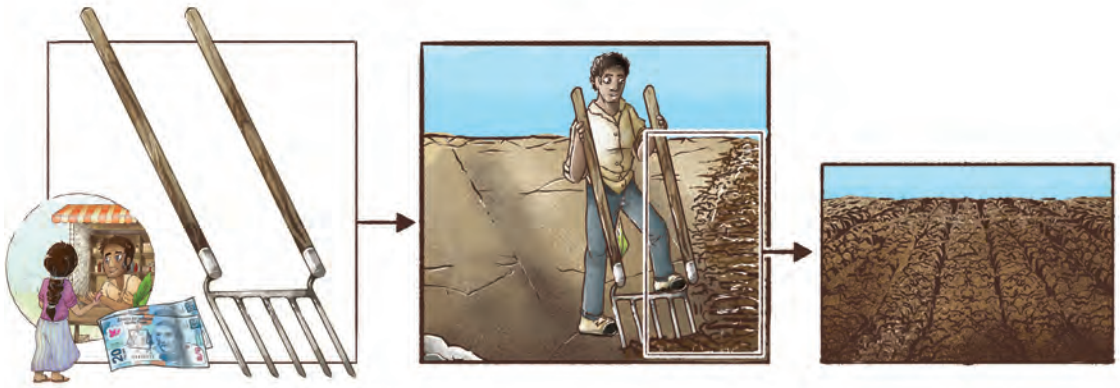
2. New tools: ask a local vendor to supply or ask blacksmith to construct



3. Wheel hoe

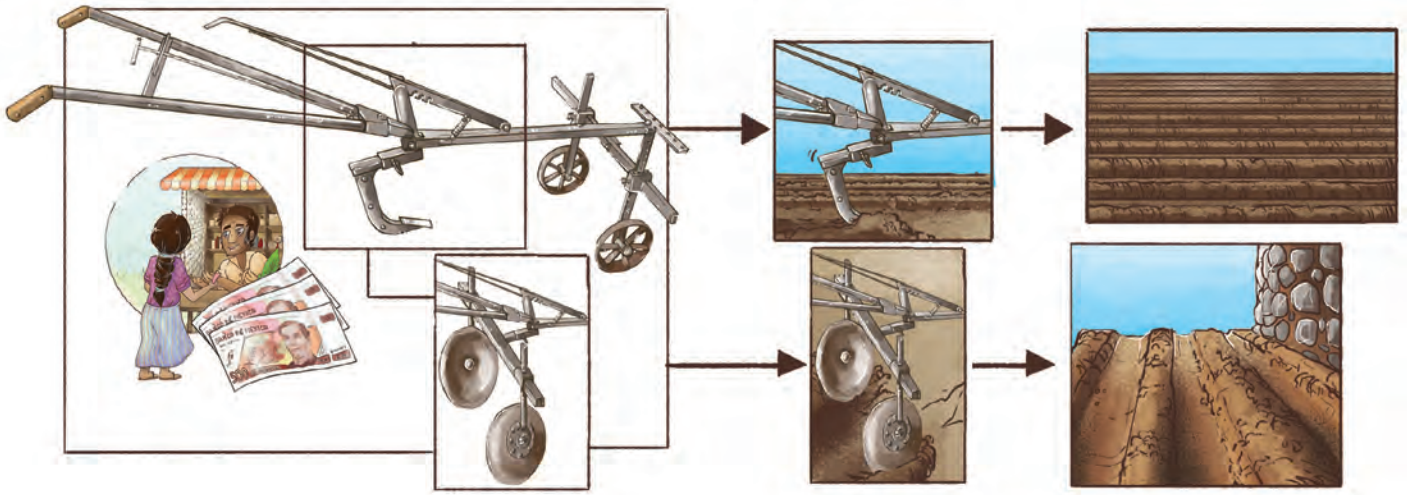
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: New tools to prepare field



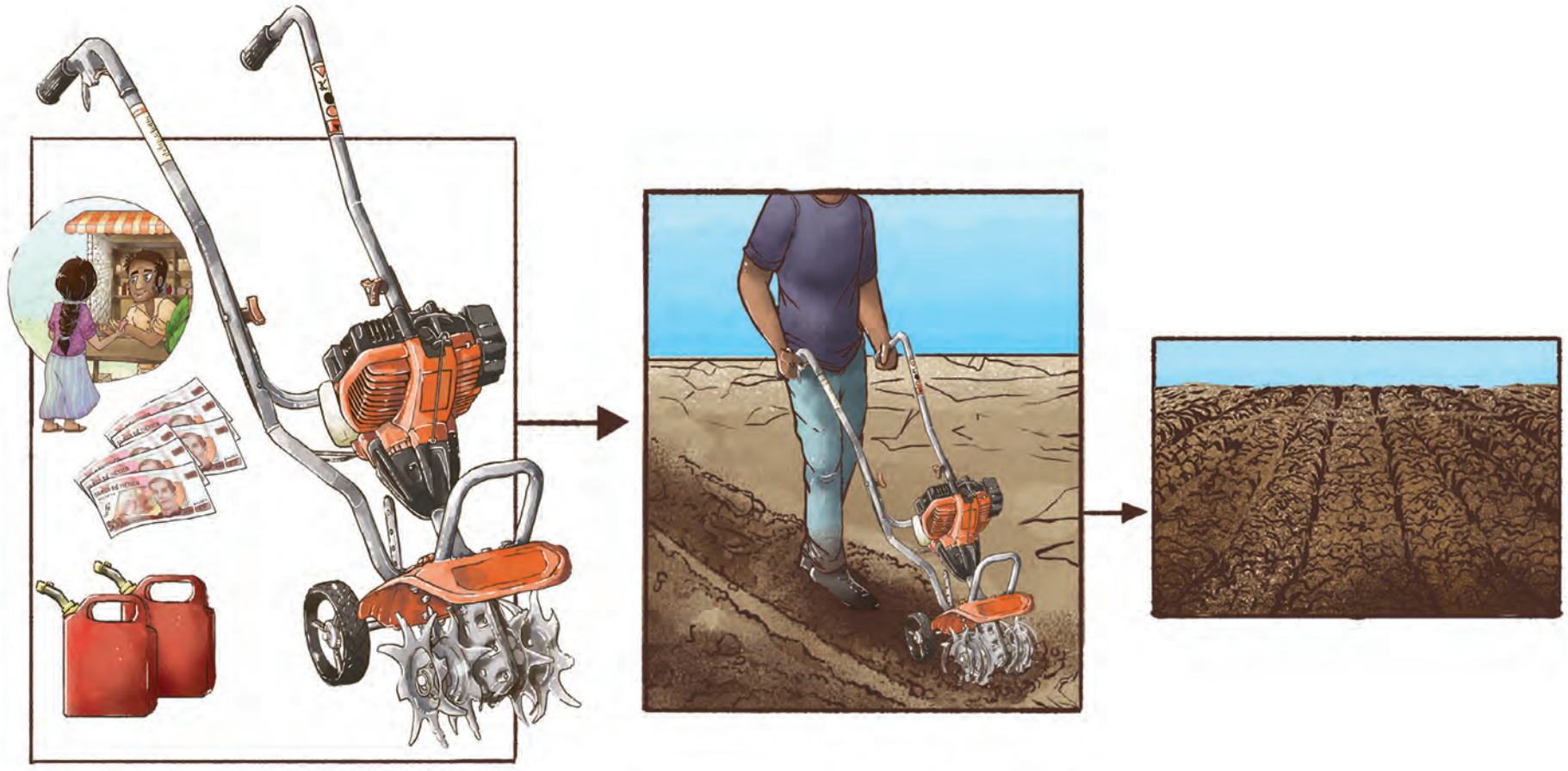
4. Broad fork to loosen soil

5. Shovel



6. Multiple attachments to one tool

Lesson: New tool to prepare field



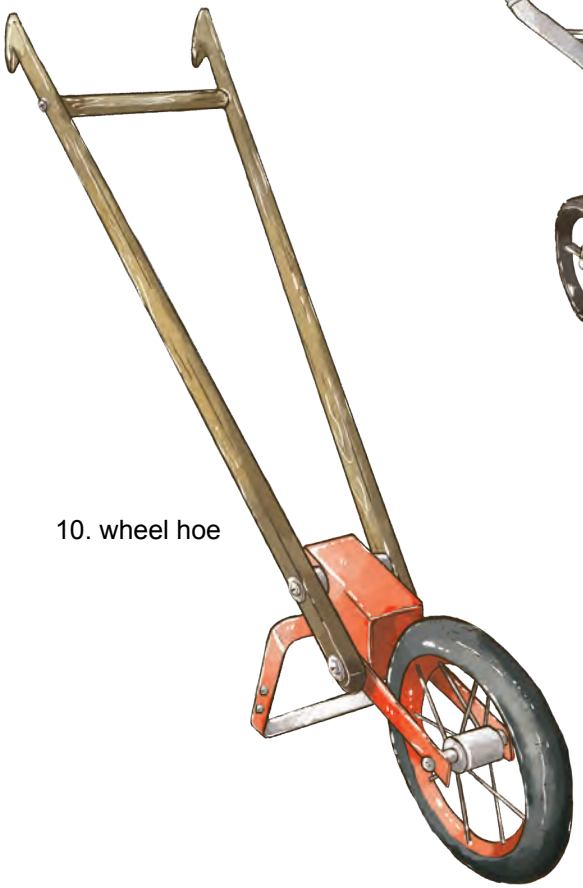
7. Petrol mini-tiller

Lesson: New tools to prepare field: detailed pictures

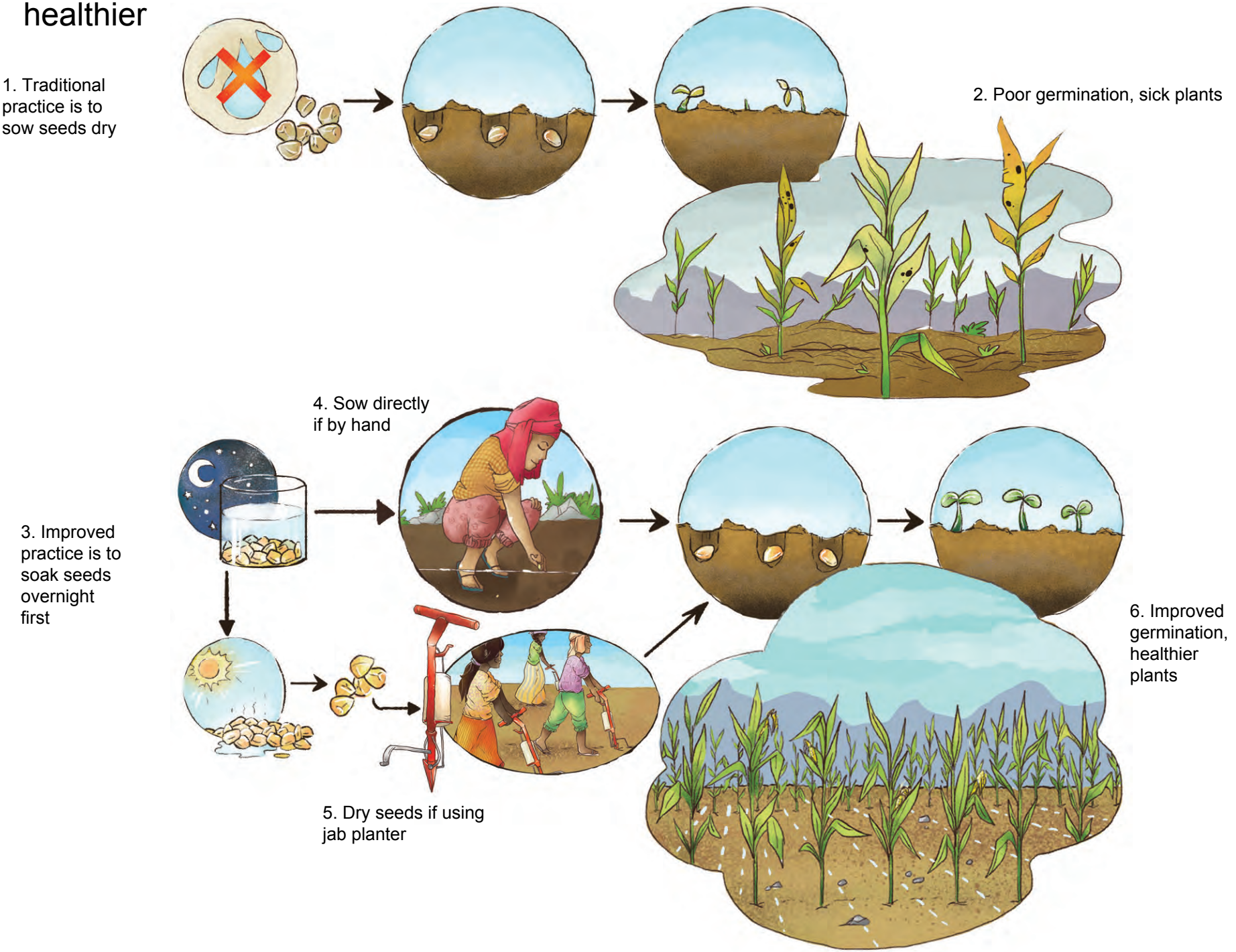
8. Multiple attachments to one tool

9. Petrol mini-tiller

10. wheel hoe



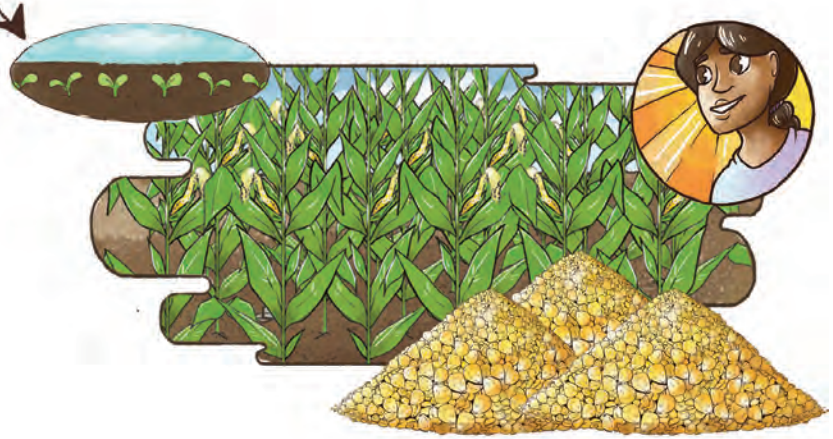
Lesson: Soaking seeds in water before planting will improve germination and make plants healthier



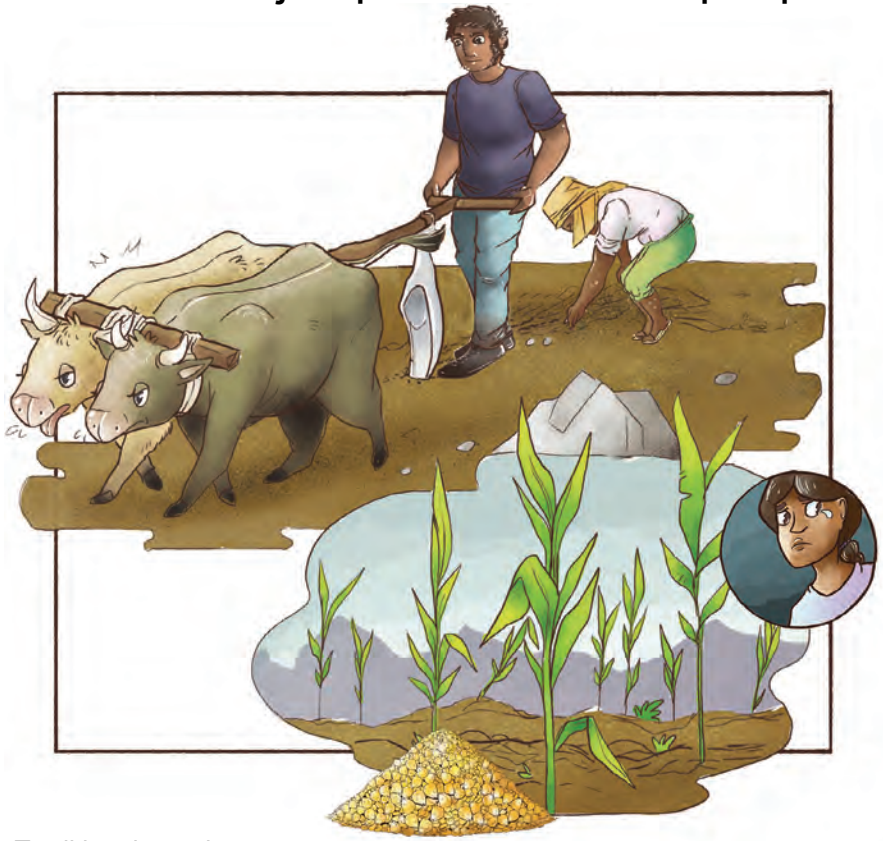
Lesson: Sowing seeds in rows can improve yields compared to broadcasting

1. Traditional practice: broadcasting

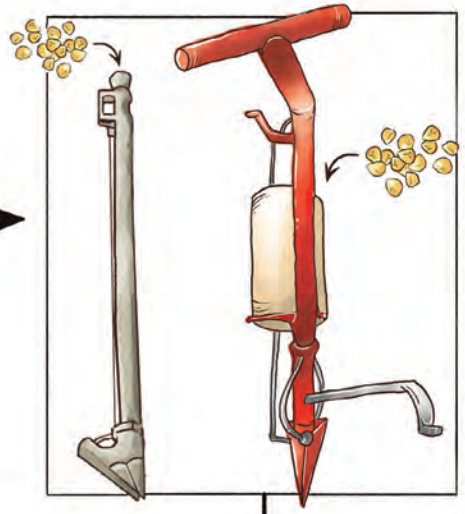
2. Improved practice: line sowing allows each plant to have equal access to sunlight and nutrients, and permits weeding and inspection for disease/pests



Lesson: A jab planter reduces people and livestock required to sow seeds

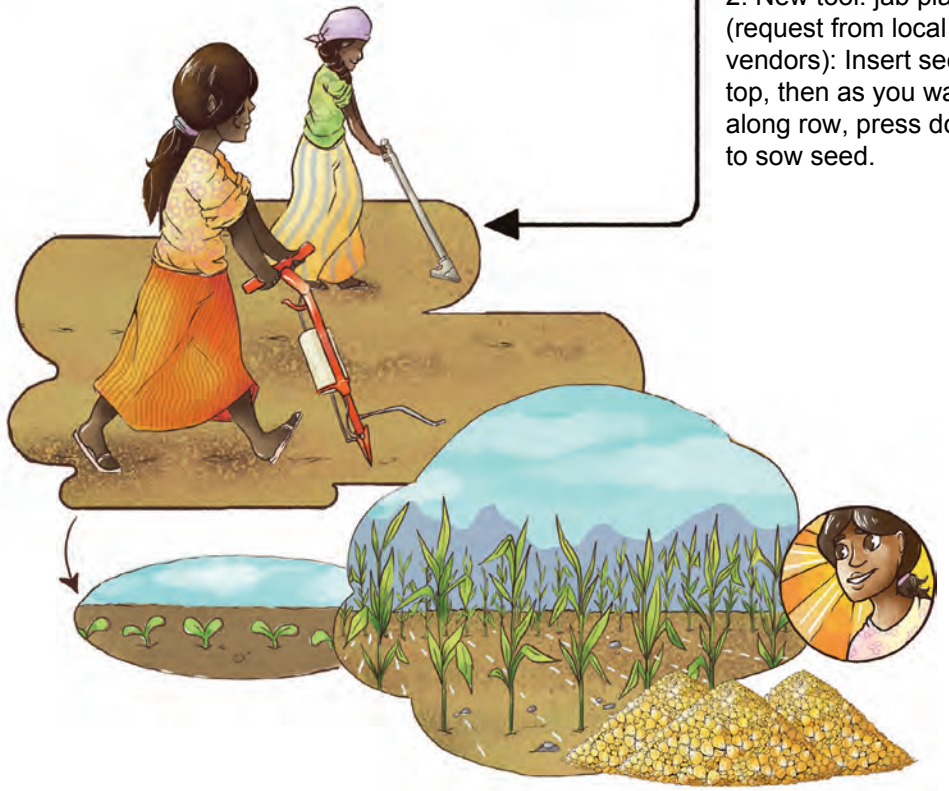


1. Traditional practice
requires cattle and 2+ people.
Difficult on steep hillside or narrow terrace.



2. New tool: jab planter (request from local vendors): Insert seed at top, then as you walk along row, press down to sow seed.

3. Single person can use



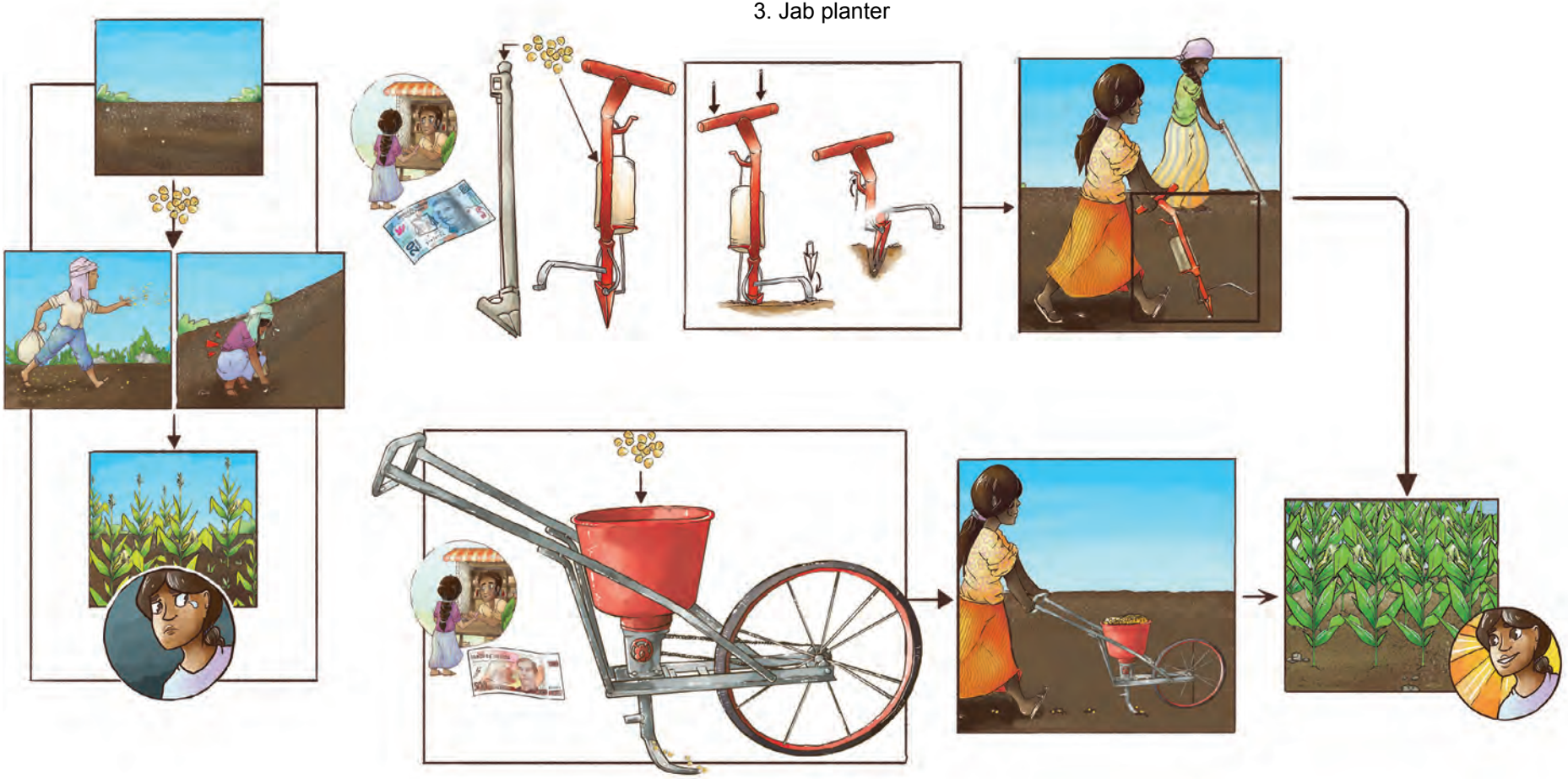
4. Helps with line sowing

Lesson: Tools to sow seeds with less labour

1. Traditional practices

2. New tools: ask local vendor to supply or blacksmith to contruct

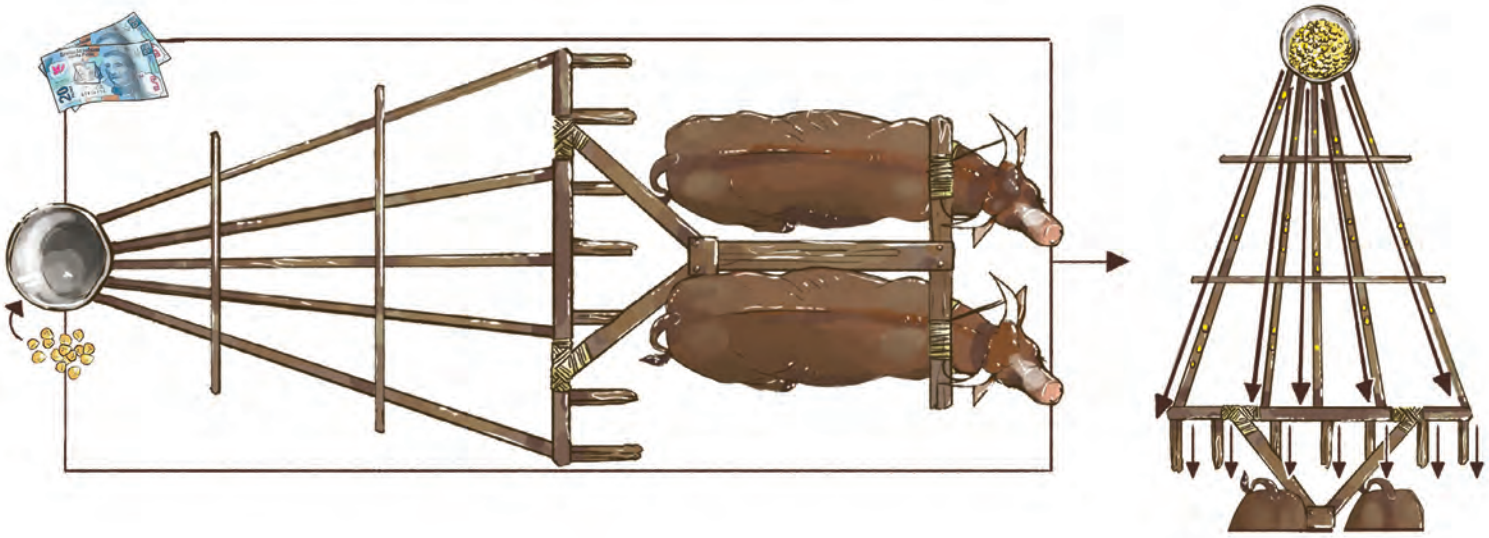
3. Jab planter

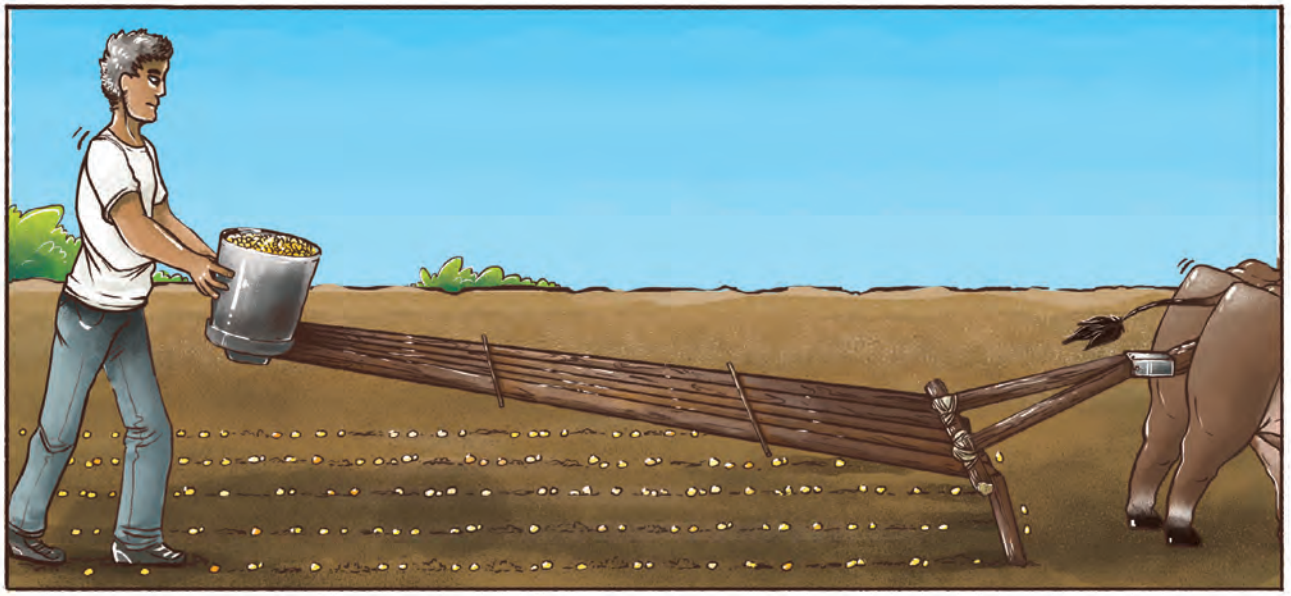


4. Wheel seeder

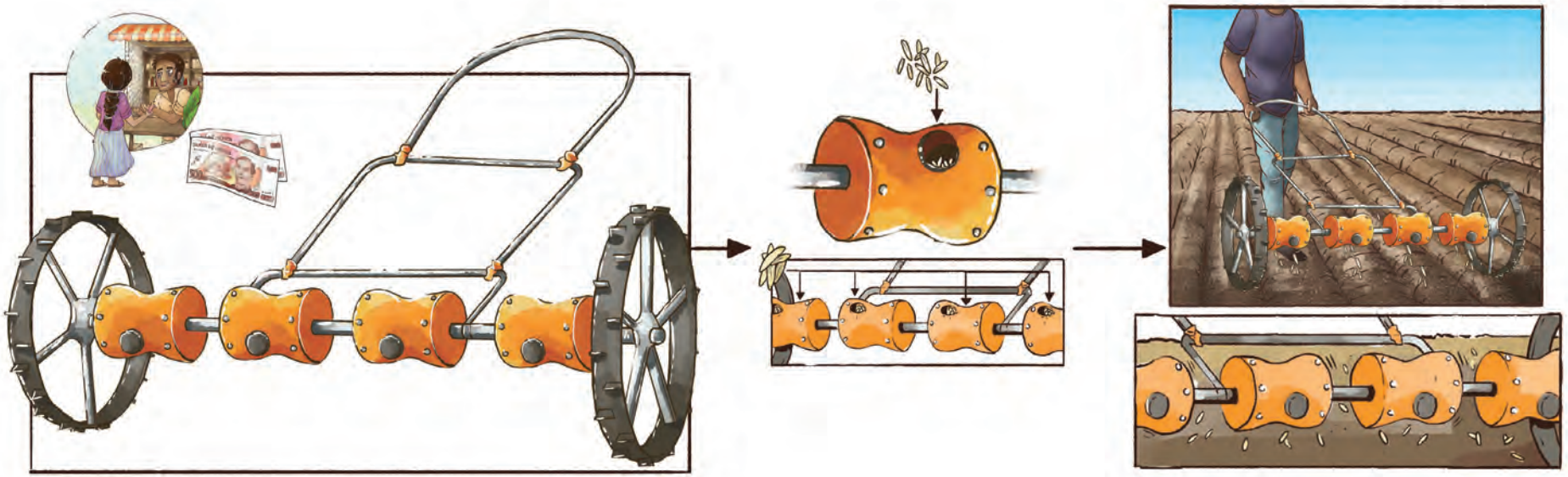
Lesson: Tools to sow seeds with less labour

1. Multiple-row cattle seeder (top view)

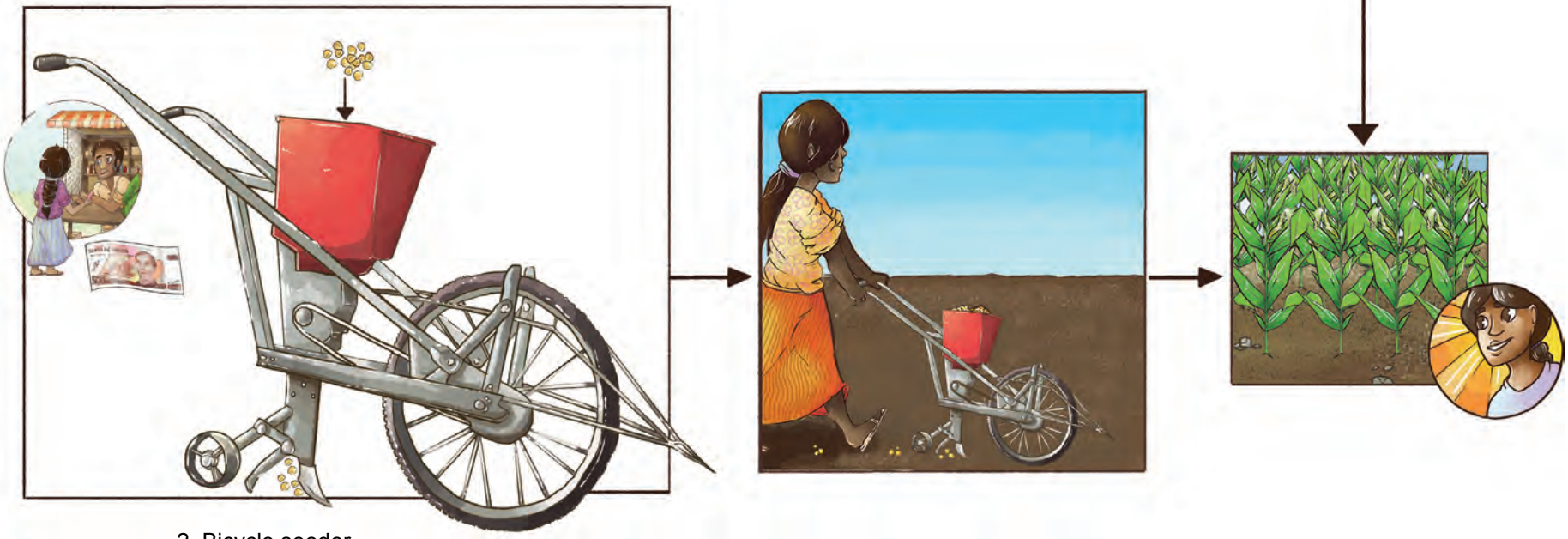




Lesson: Tools to sow seeds with less labour



1. Four-row wheel seeder for rice



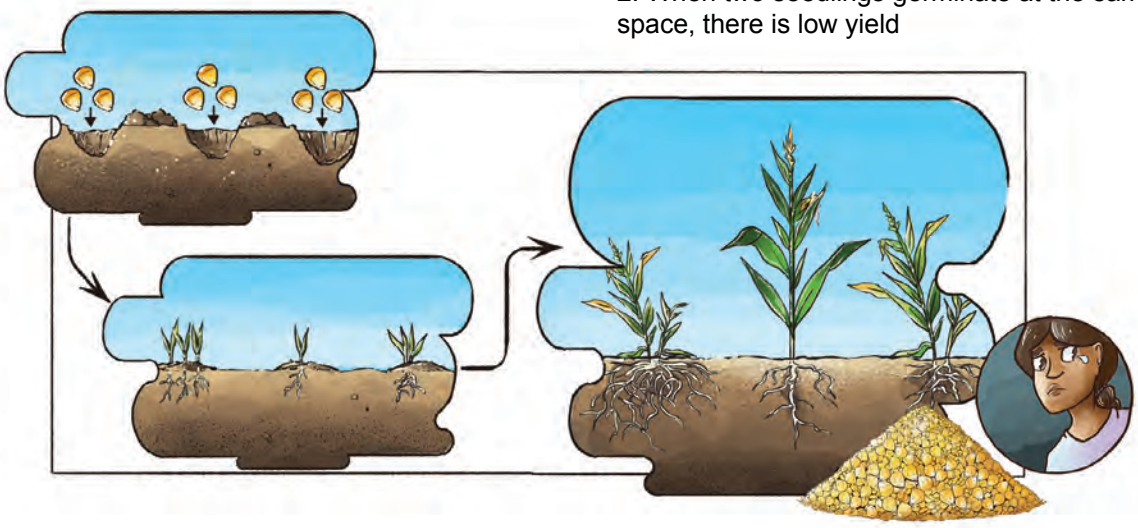
2. Bicycle seeder

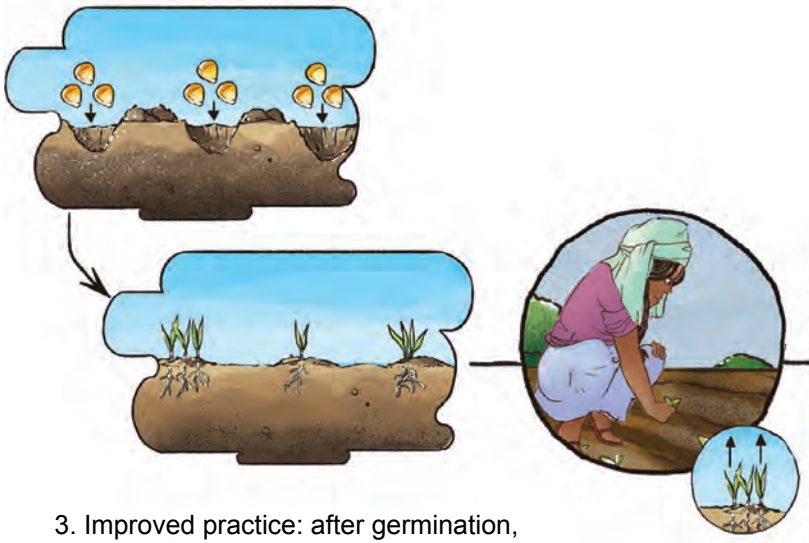
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: Thinning seedling number can improve overall yield

1. Traditional practice is to sow 2-3 seeds per hole due to low germination

2. When two seedlings germinate at the same space, there is low yield





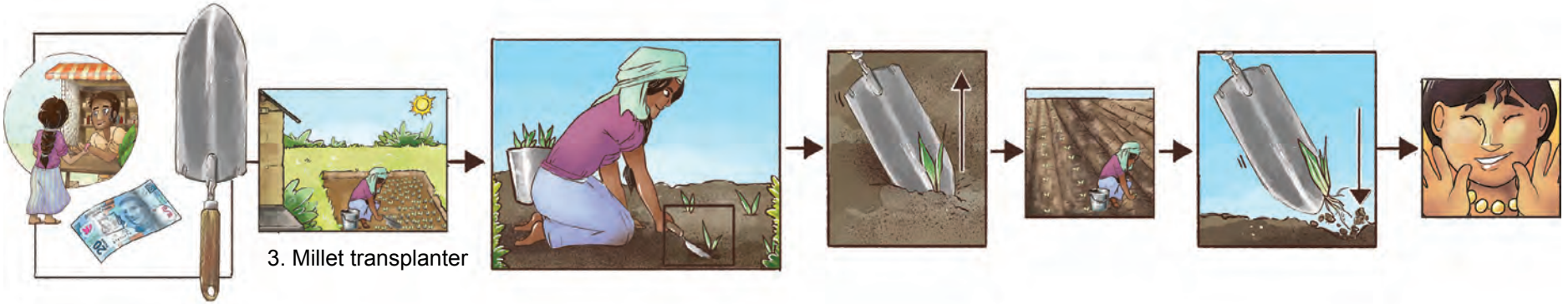
3. Improved practice: after germination, remove extra plants

4. Overall yield is higher

Lesson: Tools to reduce labour required for transplanting seedlings

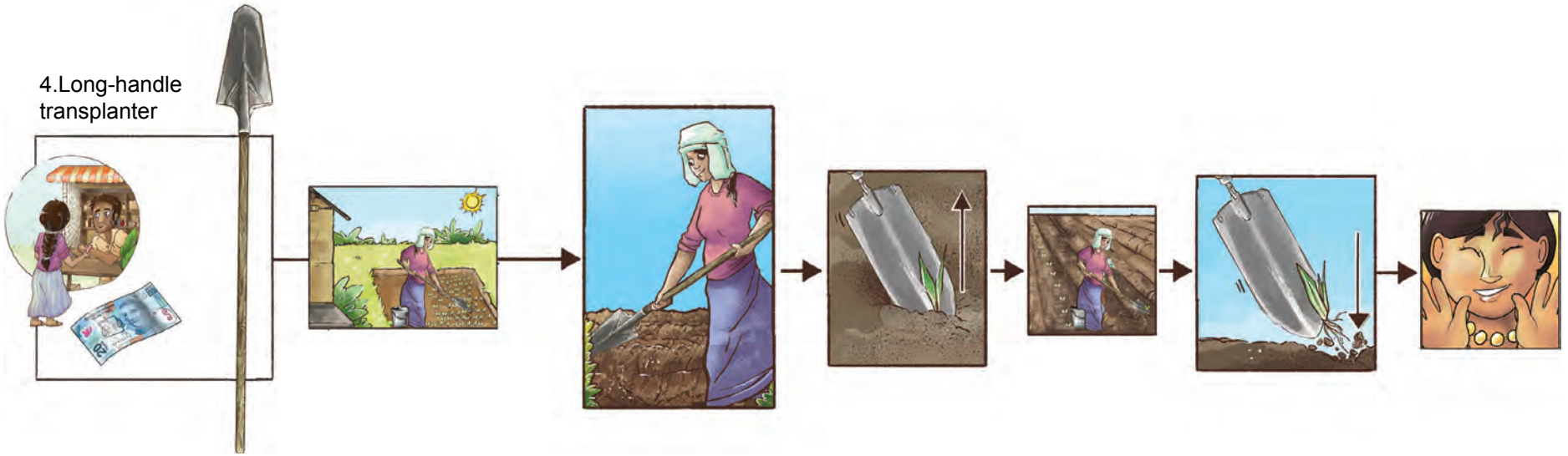
1. Traditional practice

2. New tools: ask local vendor to supply or ask blacksmith to construct

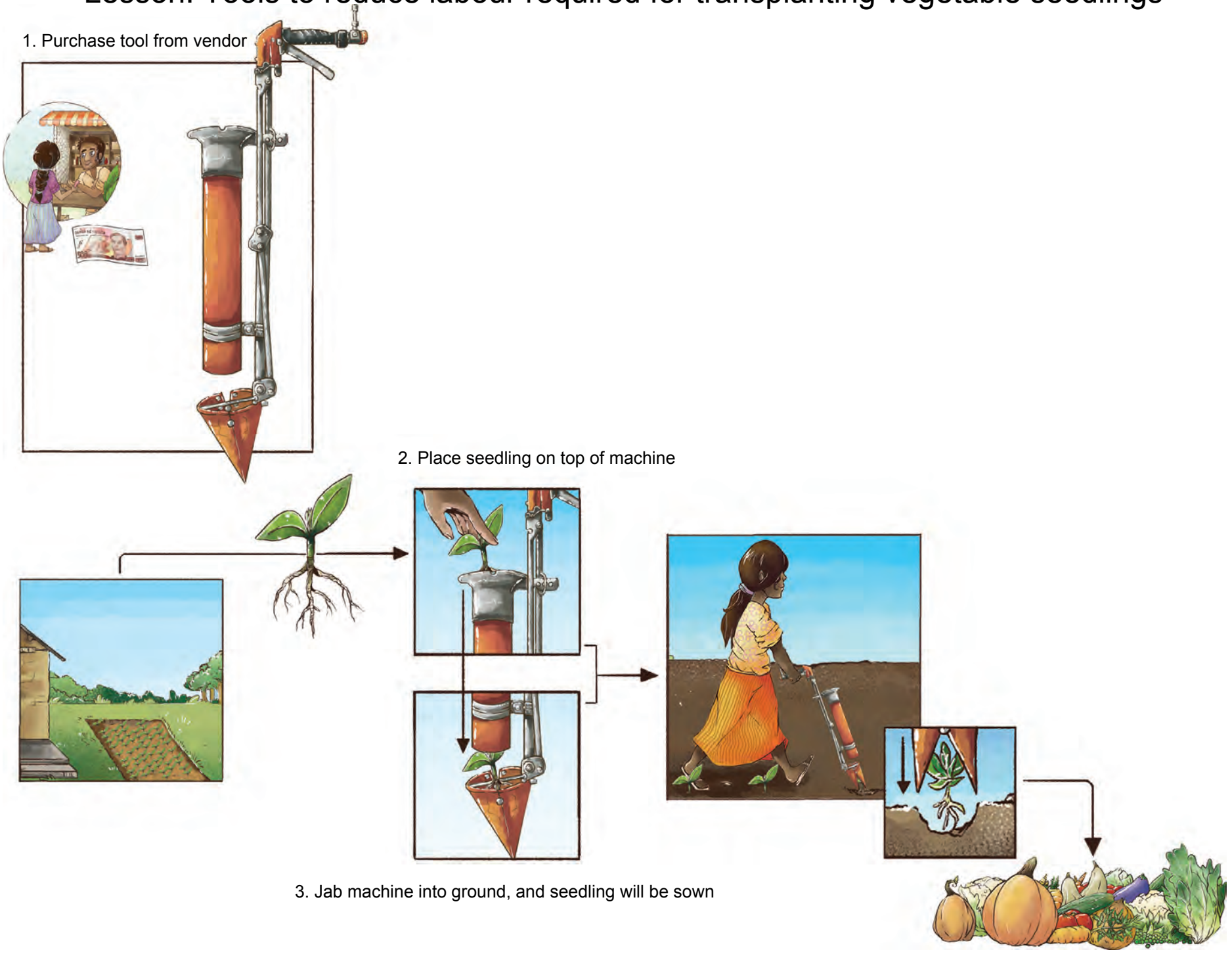


3. Millet transplanter

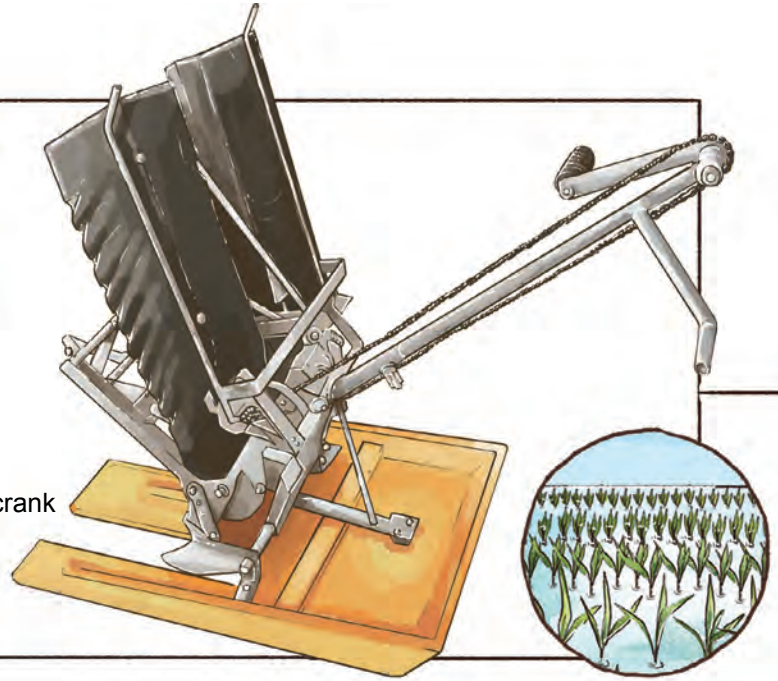
4.Long-handle transplanter



Lesson: Tools to reduce labour required for transplanting vegetable seedlings



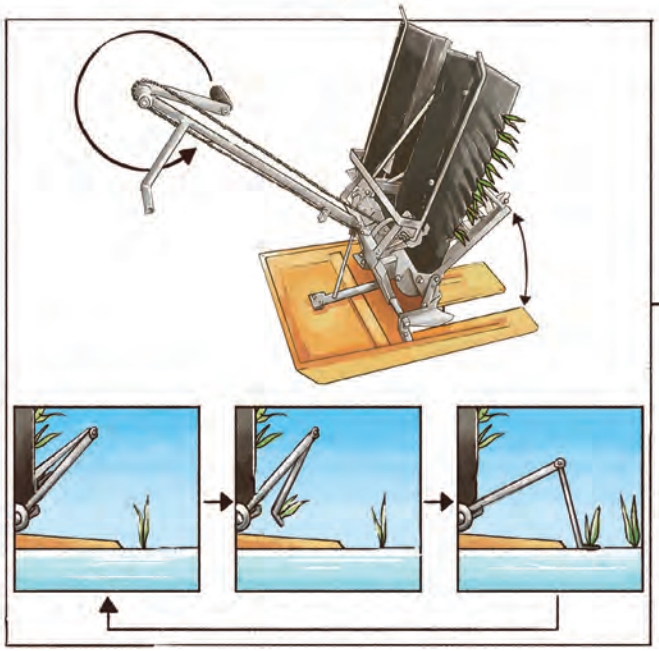
Lesson: Tools to reduce labour required for transplanting paddy rice seedlings

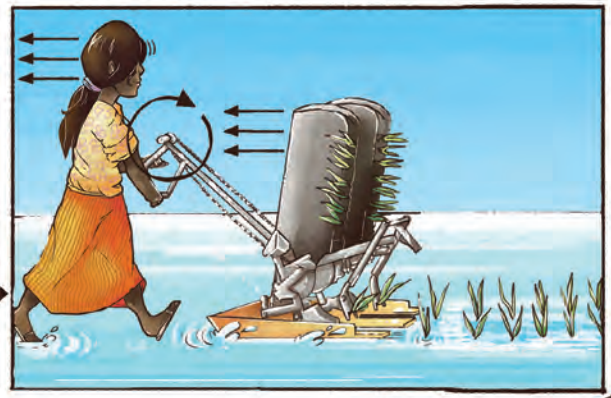


1. Purchase from vendor:
Rice transplanter with manual hand crank

2. Place seedlings into machine

3. As you walk, rotate handle which will cause seedling to be transplanted



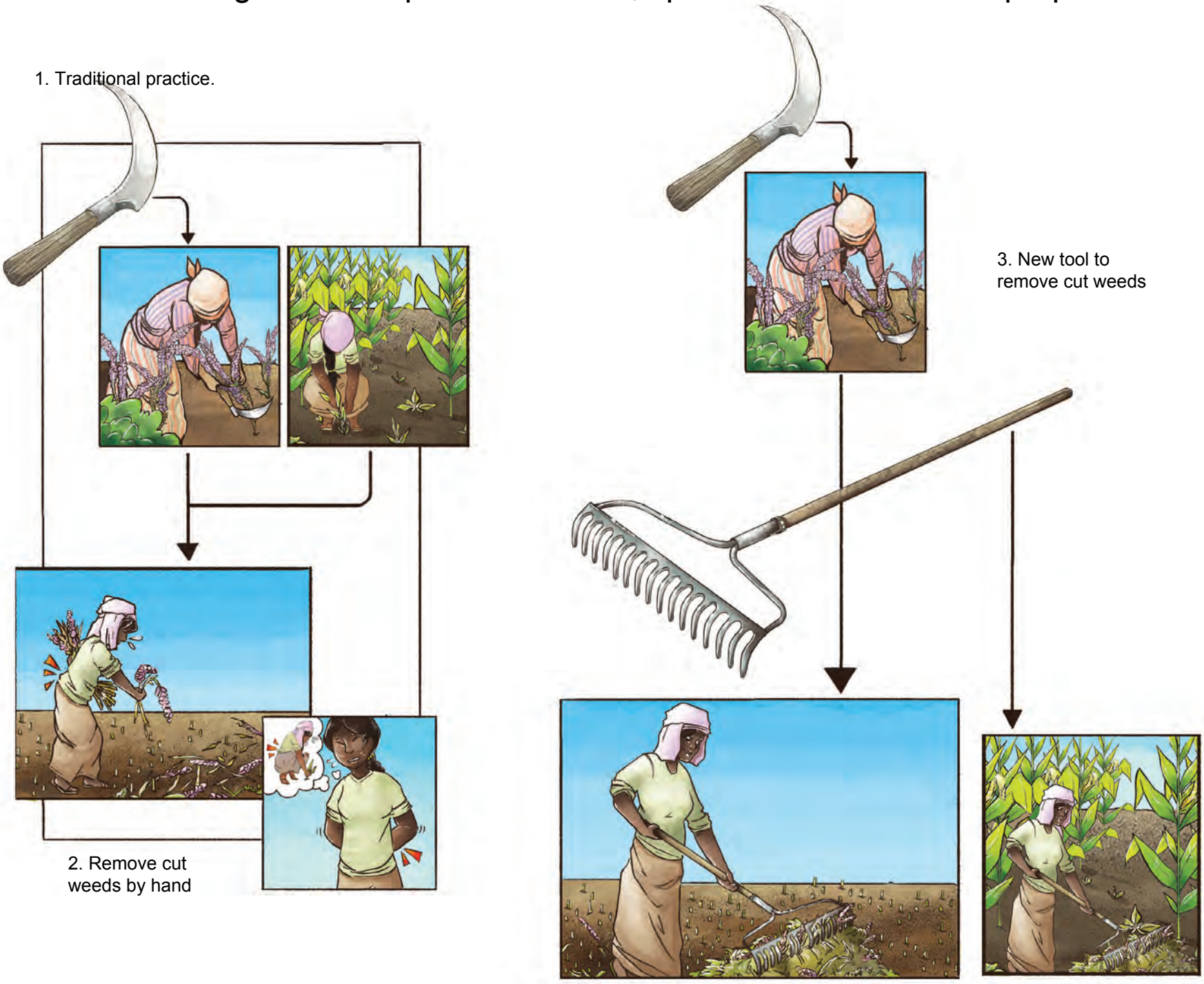


4. Must pull machine, hence walk backwards

5. There are also other rice planters that use petrol but they are more expensive

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

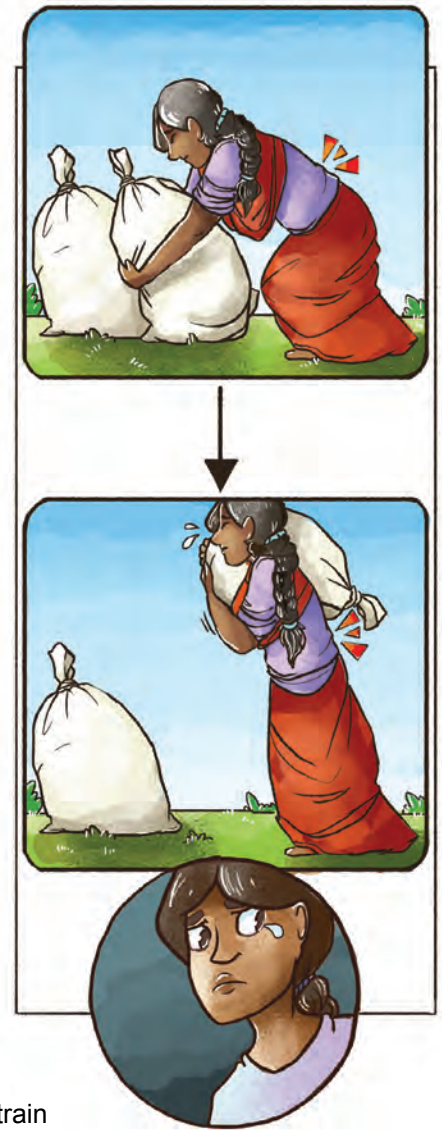
Lesson: A raking tool to help collect weeds, spread manure or other purposes



Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

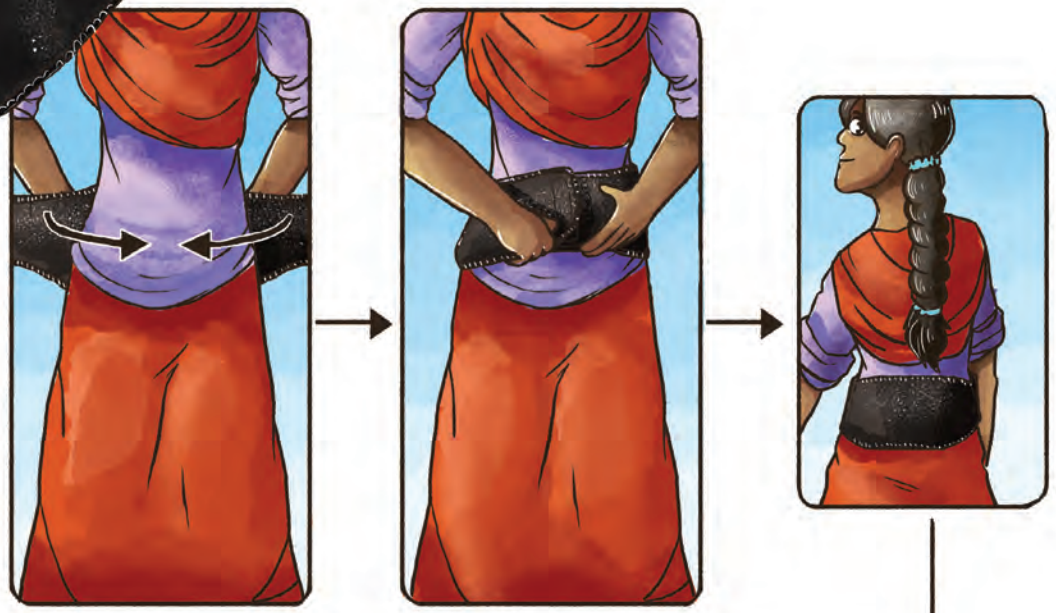
Lesson: A back support can prevent strain and injury when lifting.

1. Traditional practice

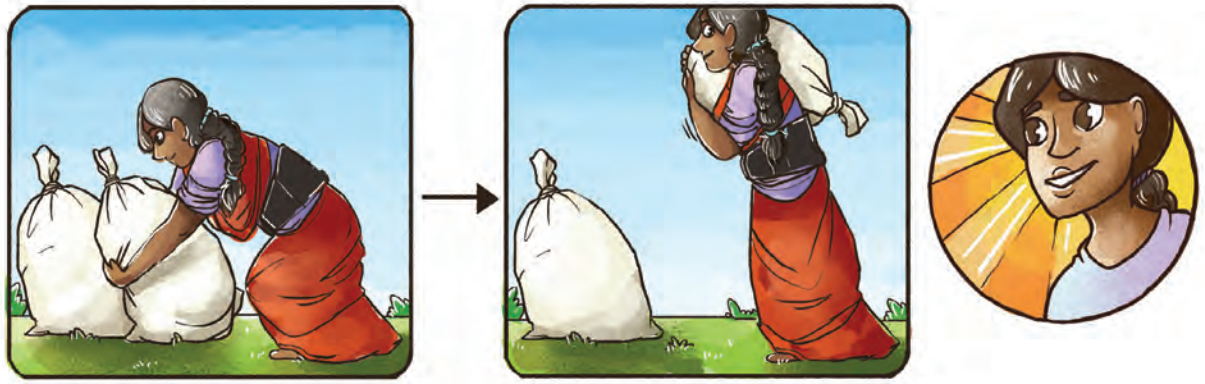


2. Strain
to back and pain

3. Improved practice: purchase a back support
from vendor and tie around waist (on top or under clothes)

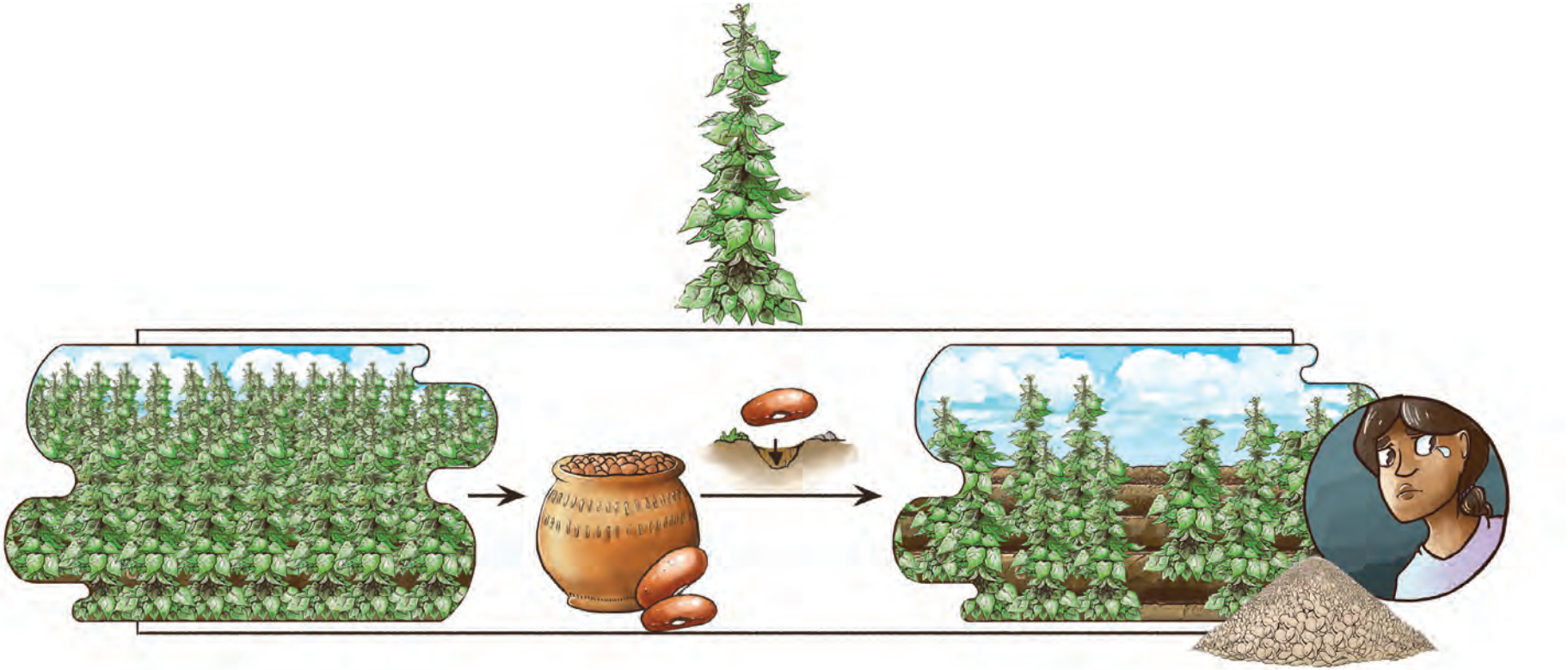


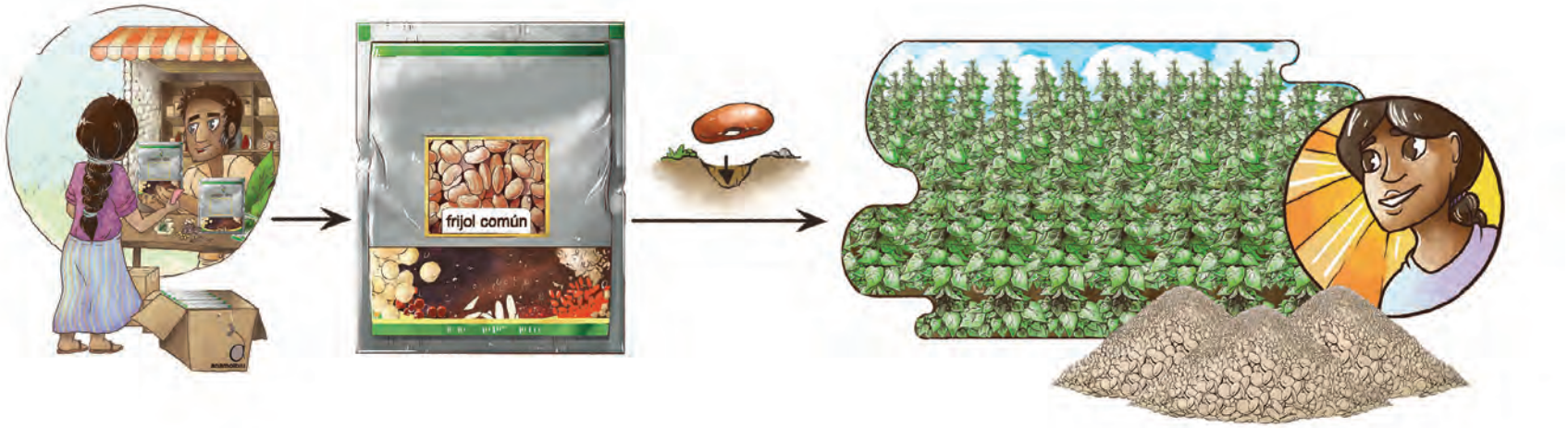
4. Less strain and pain



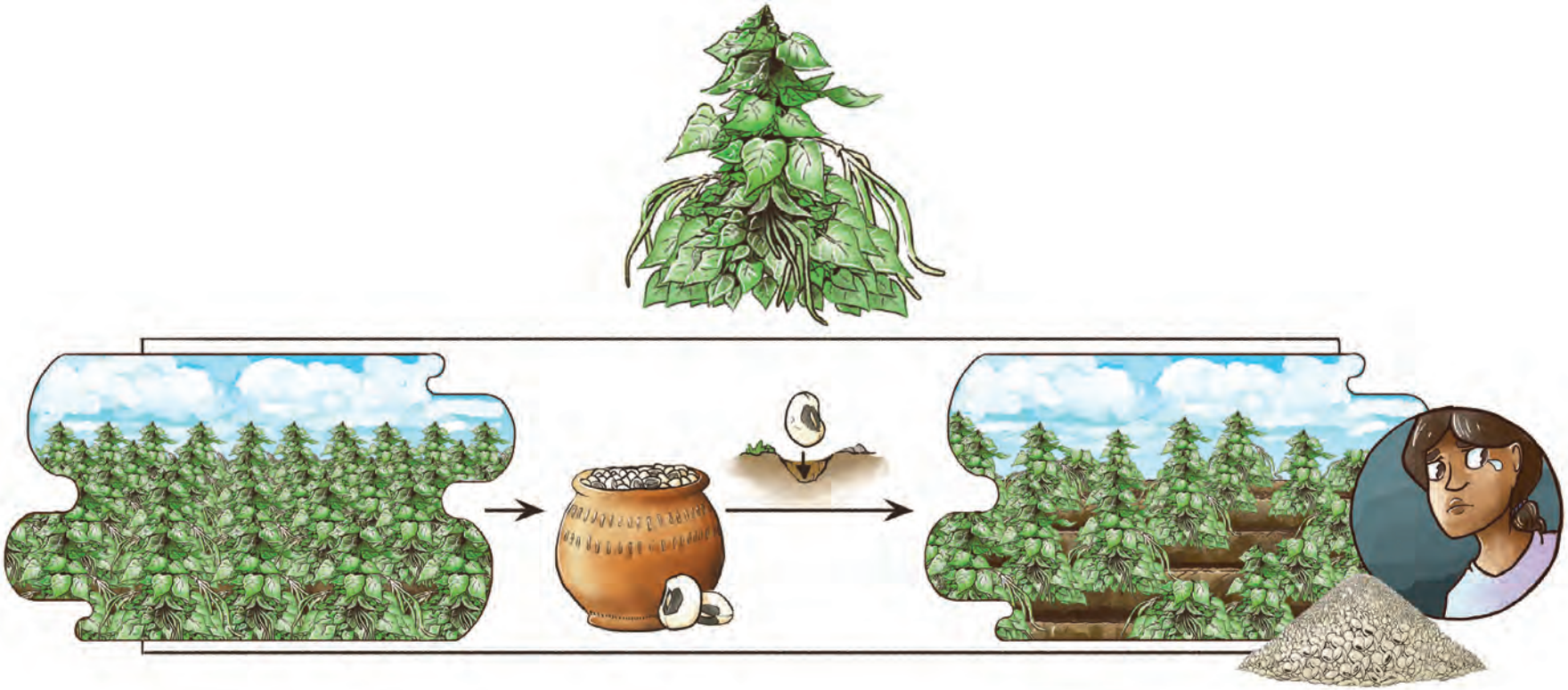
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

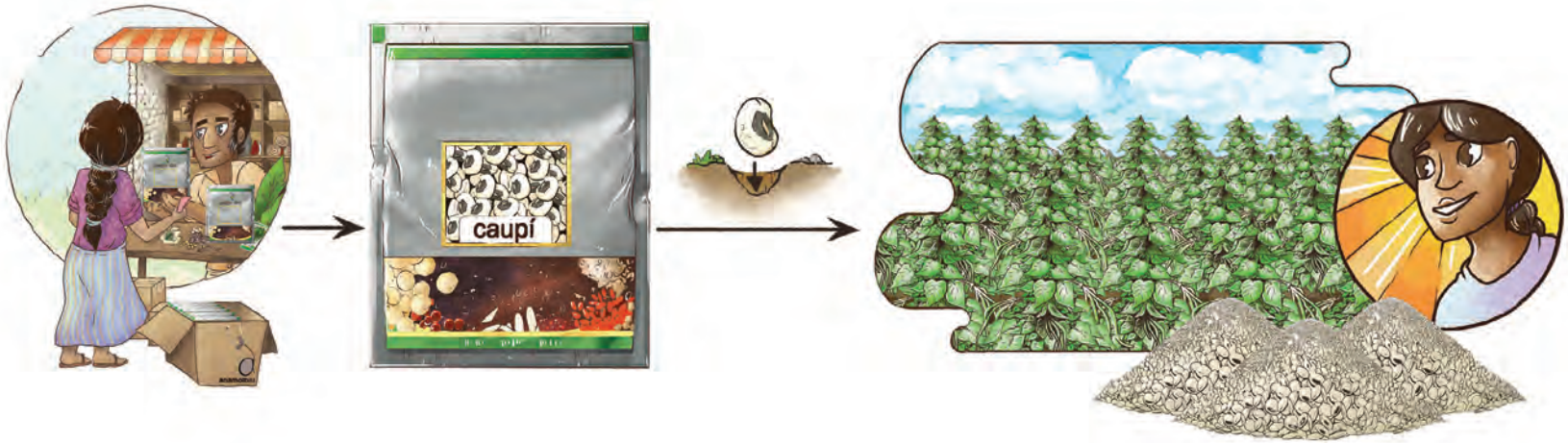
Chapter 3: **Crop & Tree Intensification**

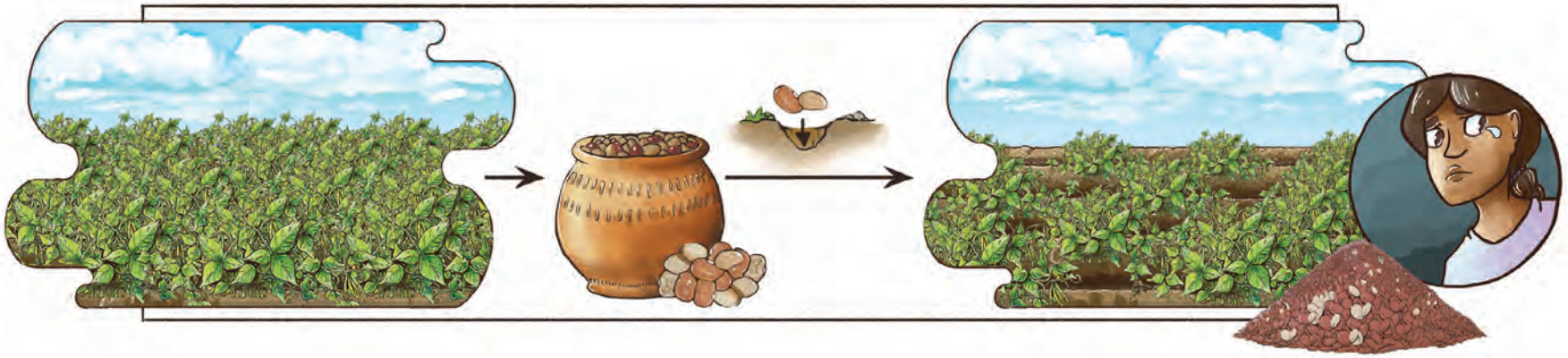


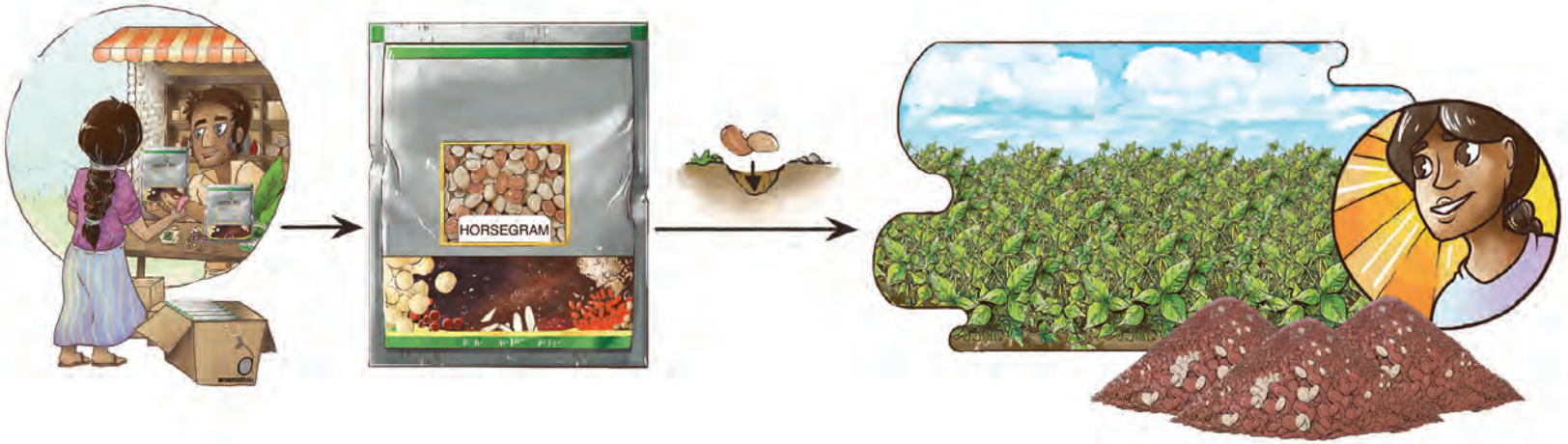


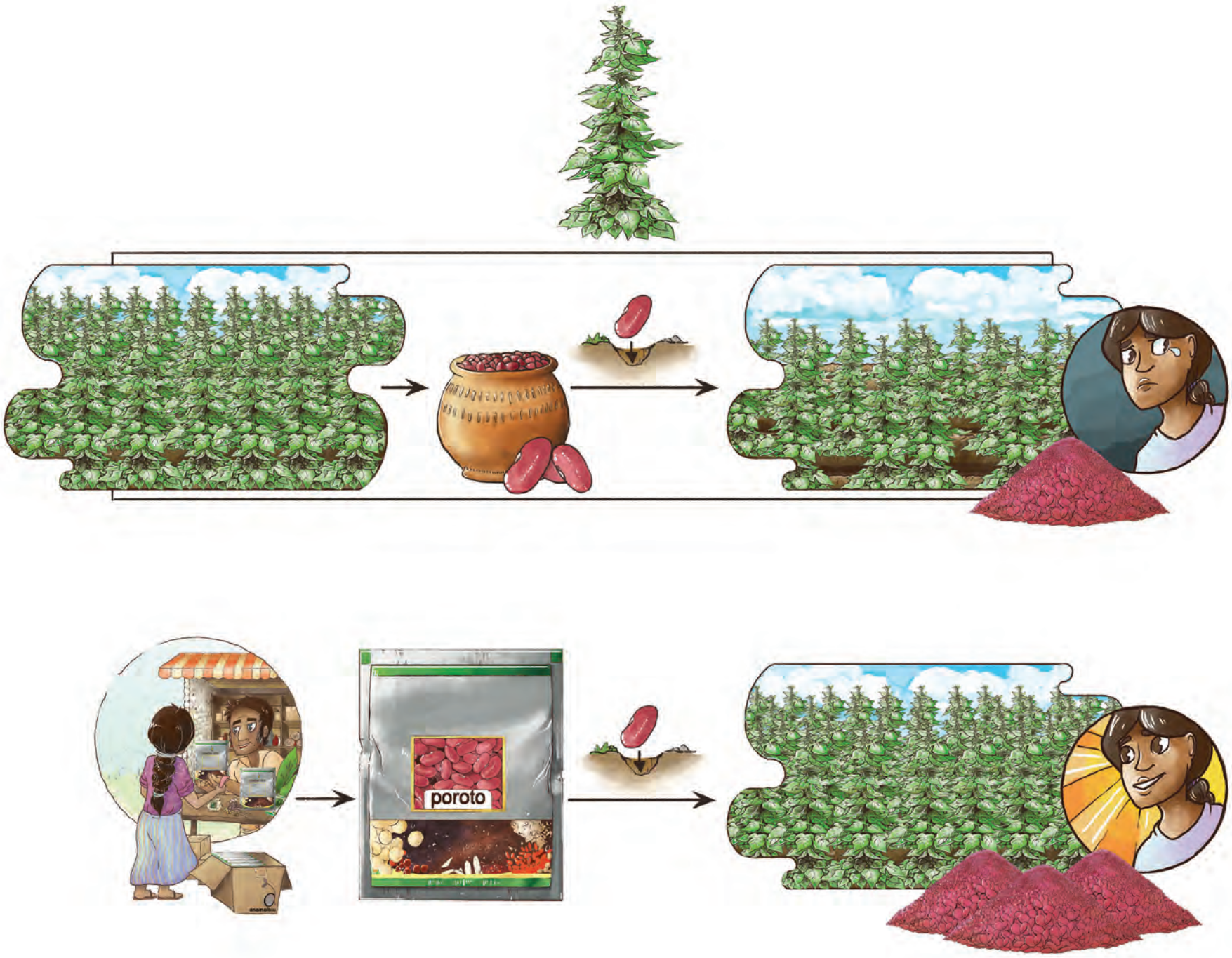
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

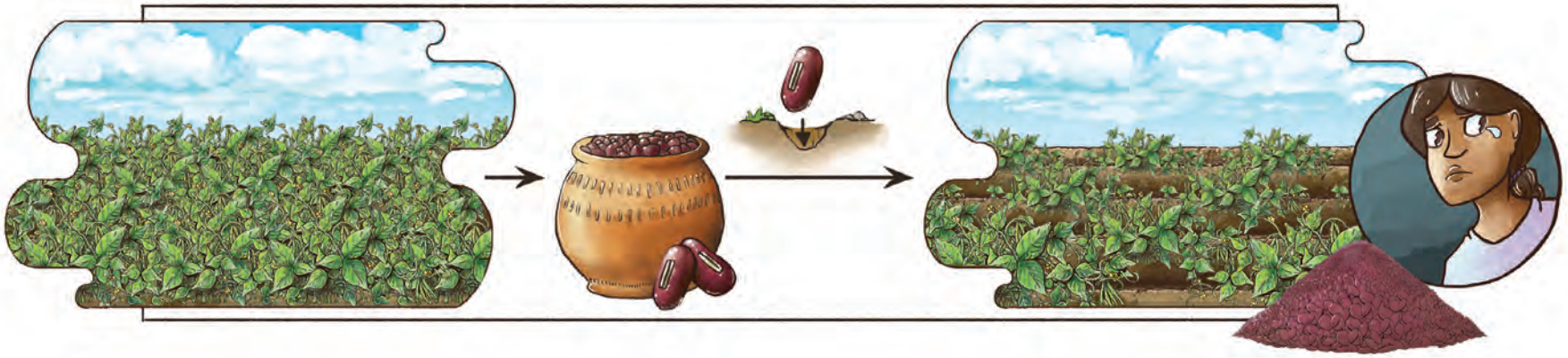


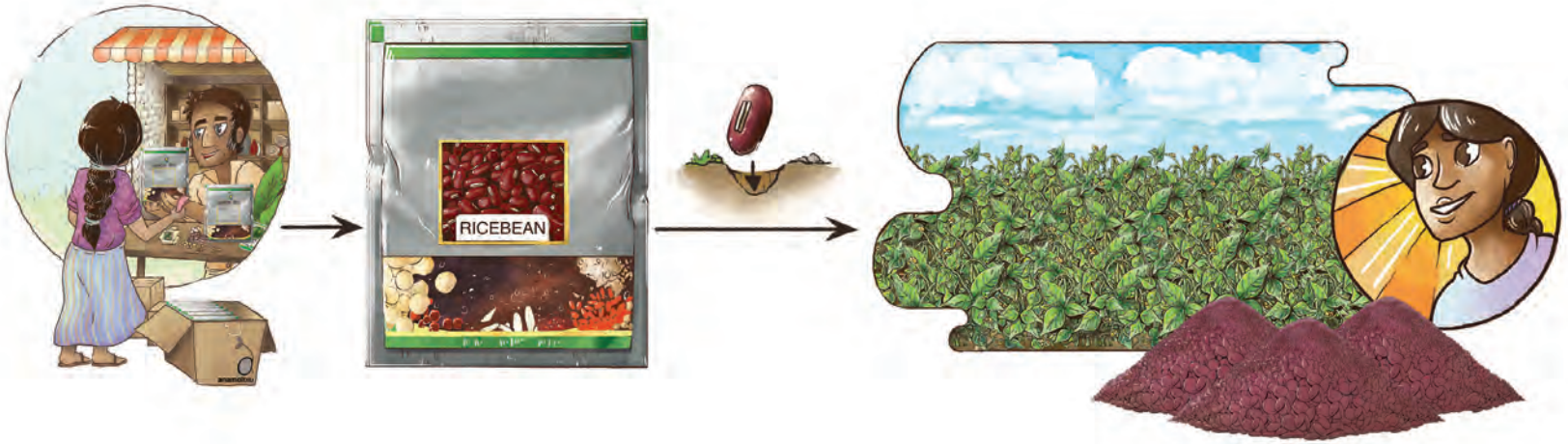




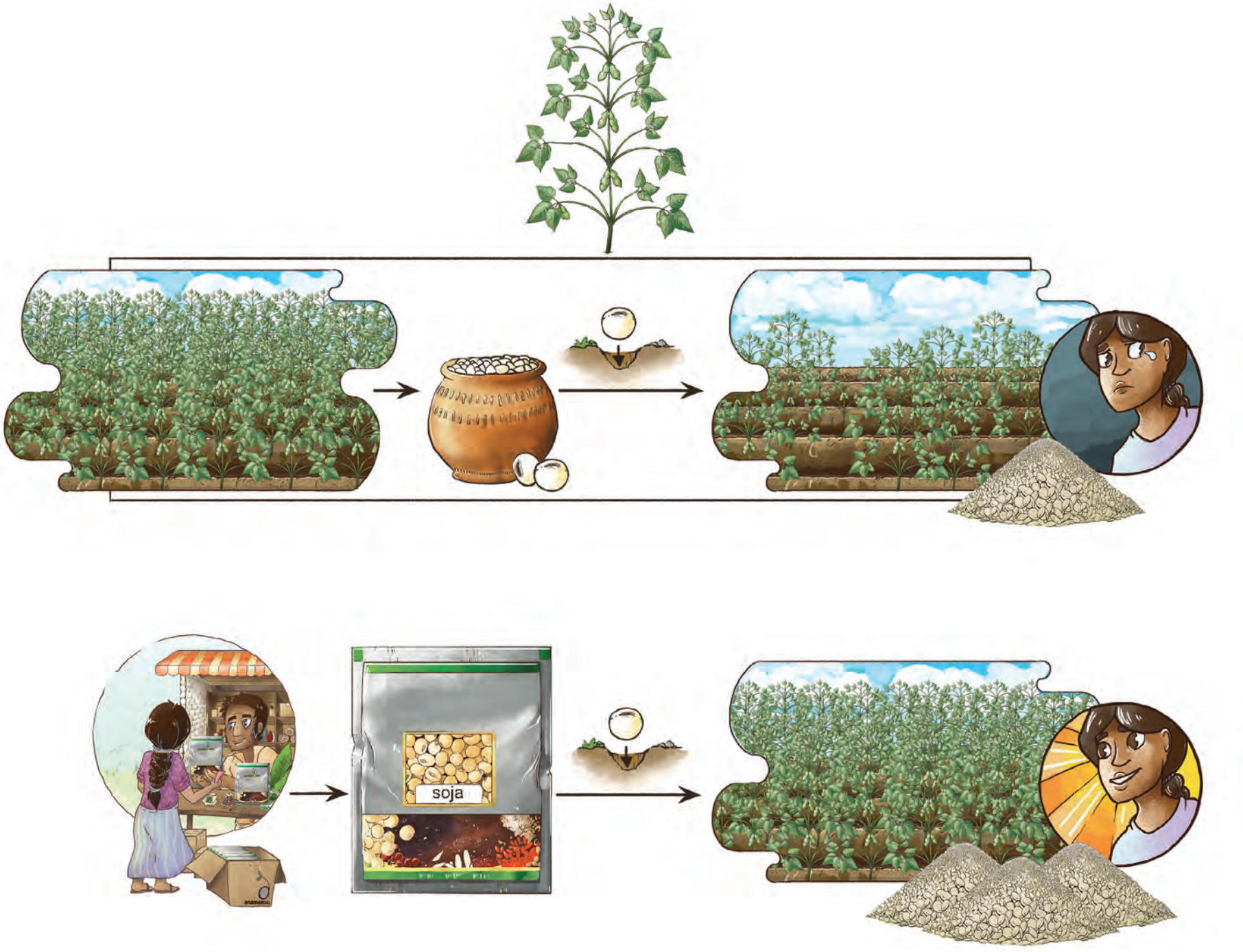




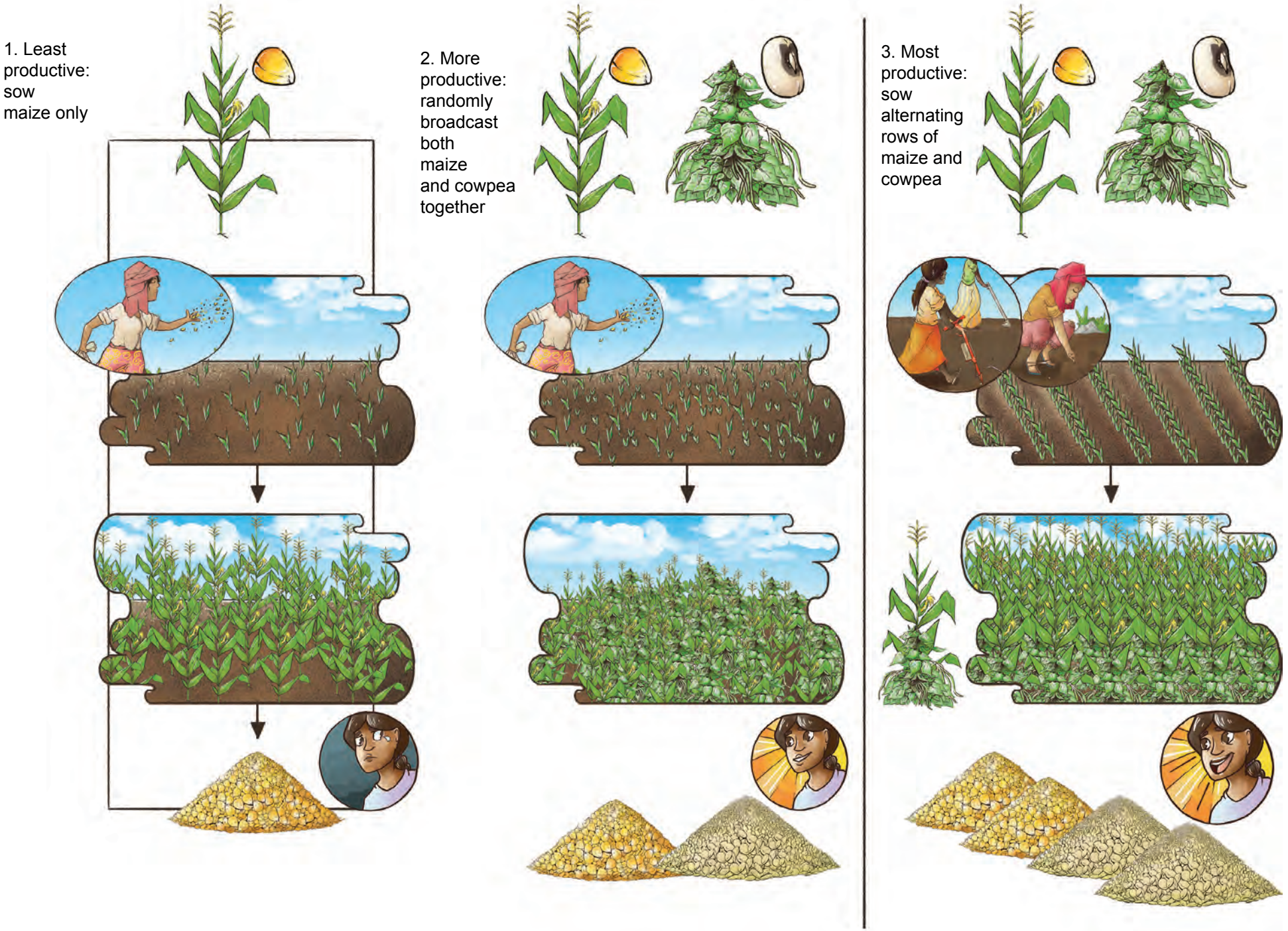




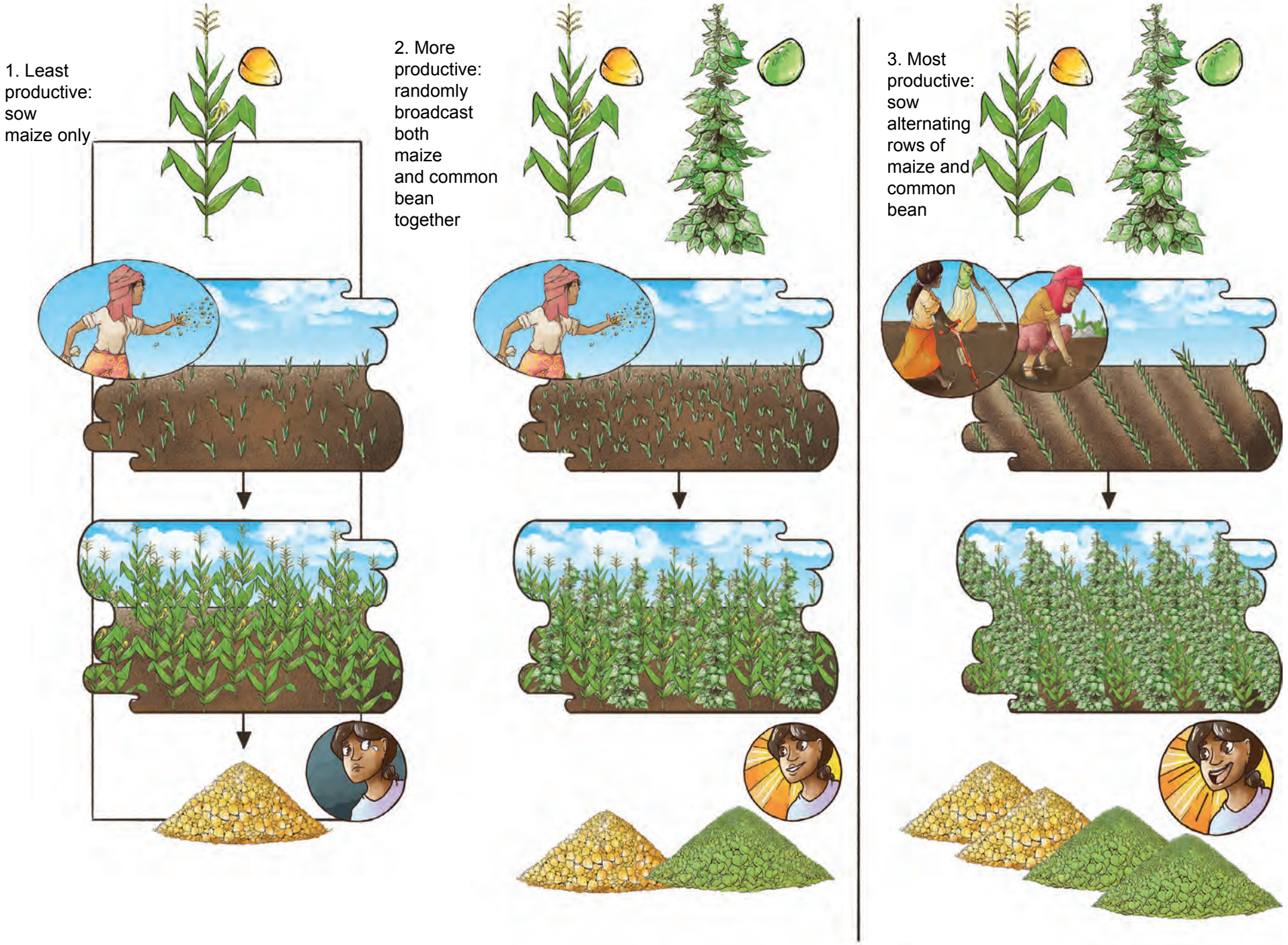
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons



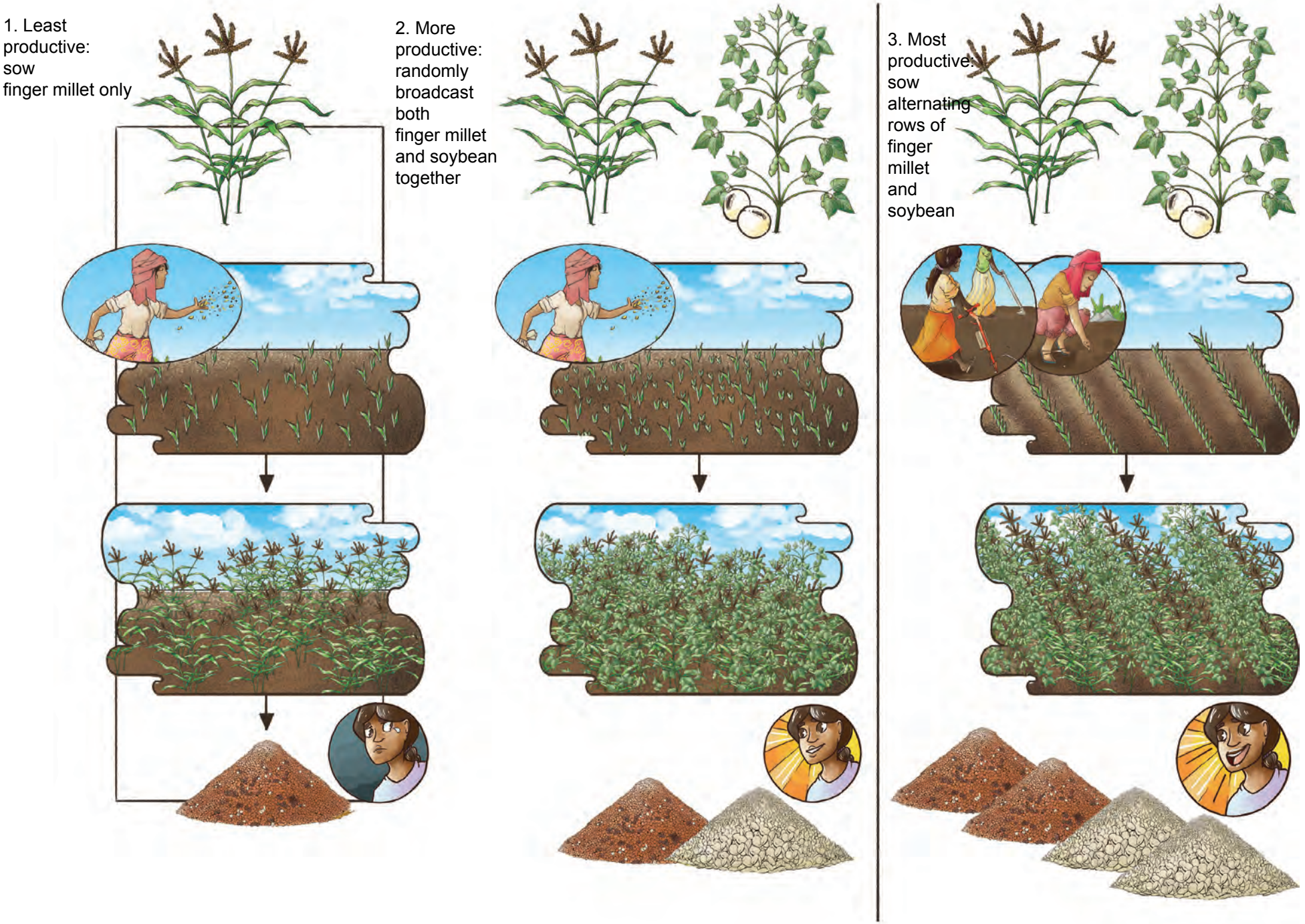
Lesson: Sowing maize together with cowpea will yield more profit than maize only.



Lesson: Sowing maize together with common bean will yield more profit than maize only.



Lesson: Sowing finger millet together with soybean will yield more profit than millet only.



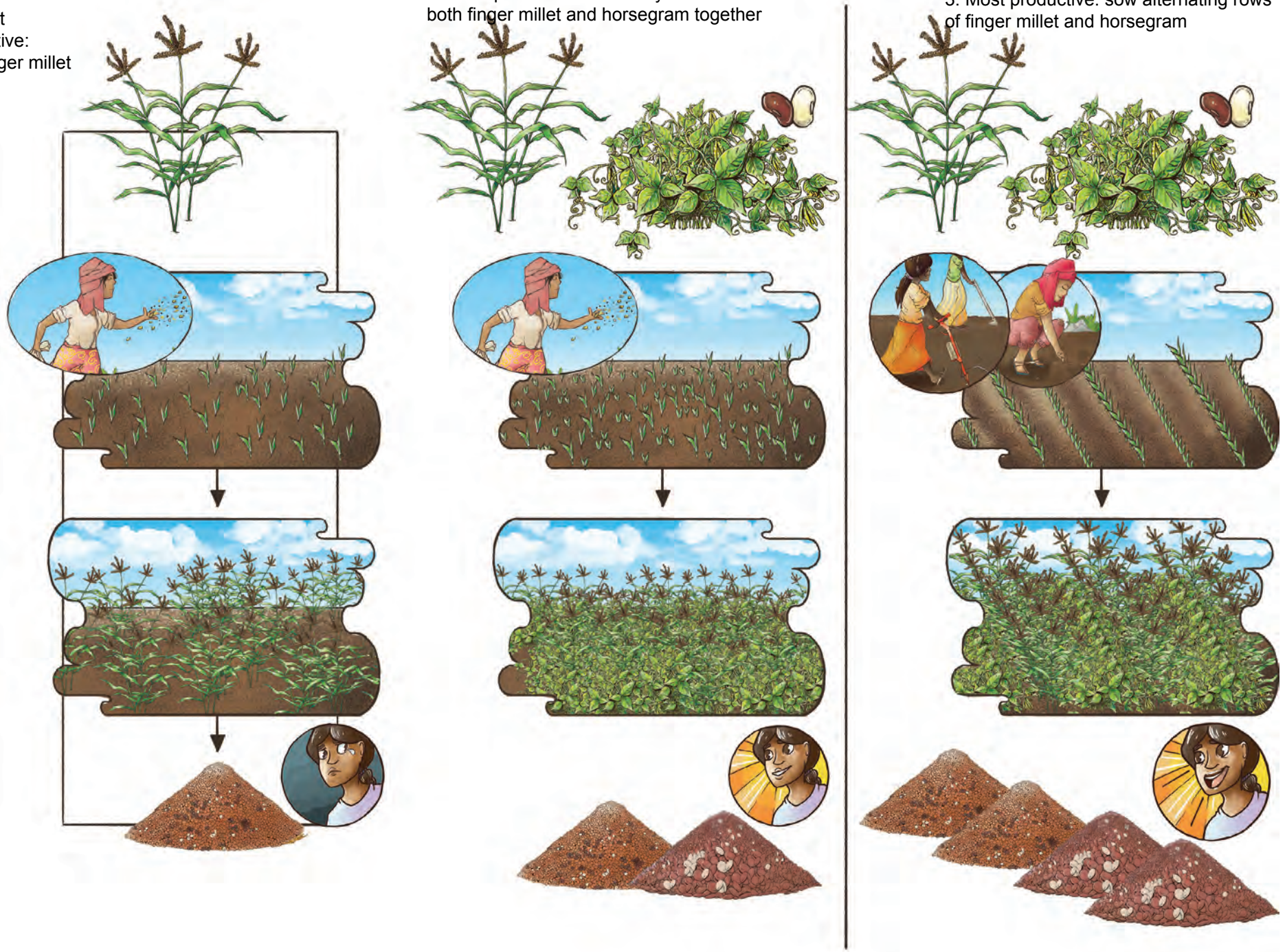
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Sowing finger millet together with horsegram will yield more profit than millet only.

1. Least productive: sow finger millet only

2. More productive: randomly broadcast both finger millet and horsegram together

3. Most productive: sow alternating rows of finger millet and horsegram

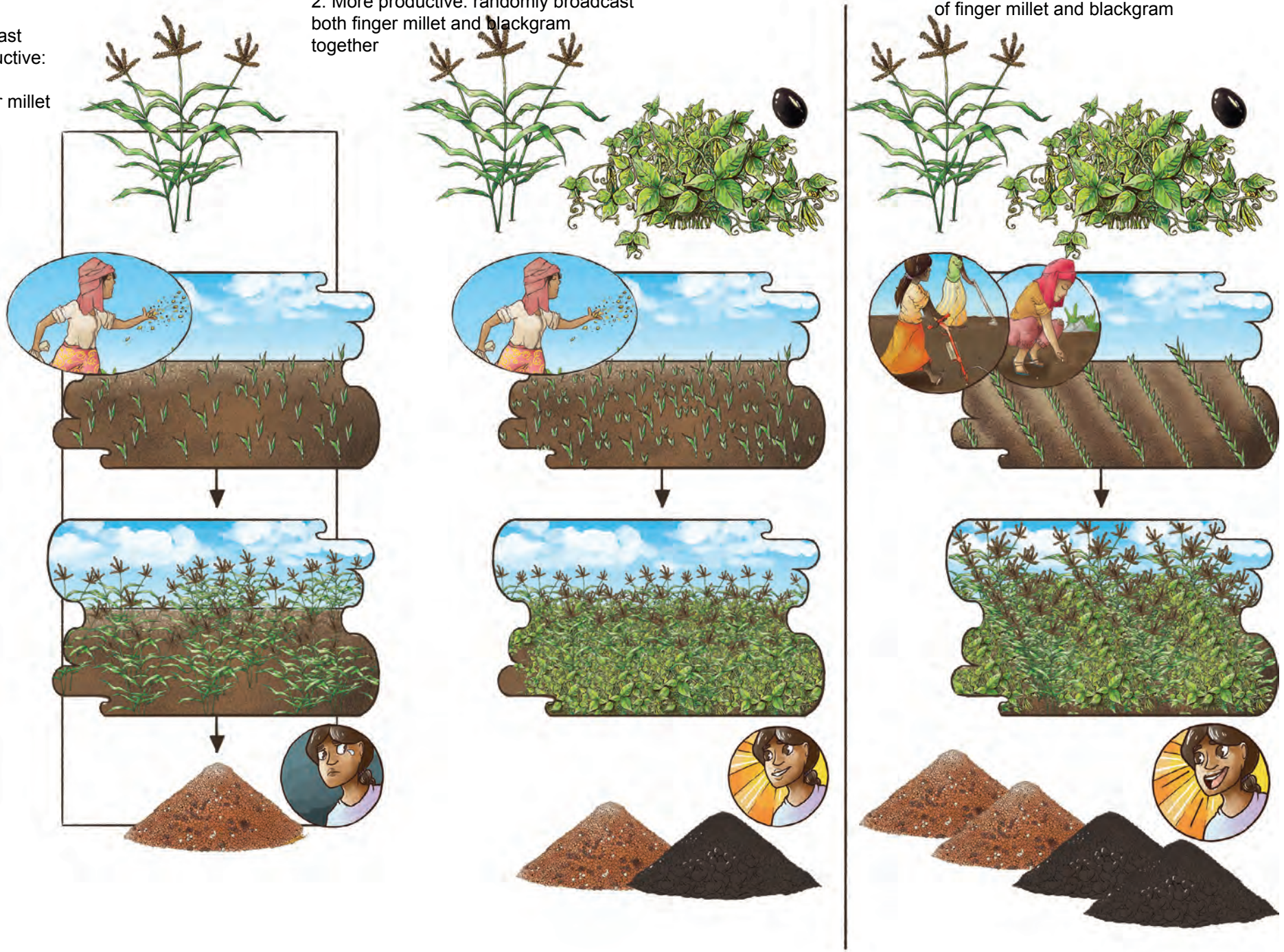


Lesson: Sowing finger millet together with blackgram will yield more profit than millet only.

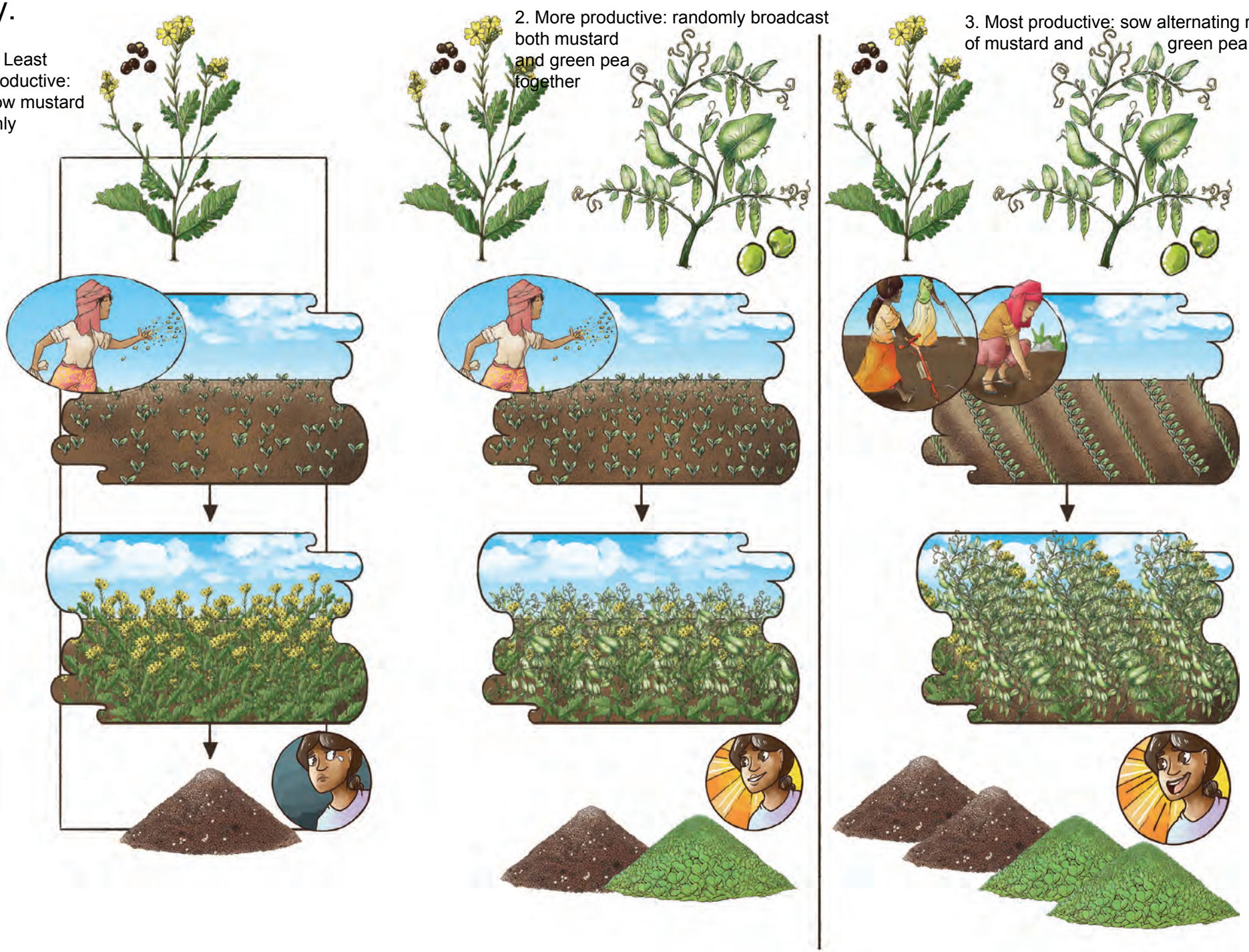
1. Least productive: sow finger millet only

2. More productive: randomly broadcast both finger millet and blackgram together

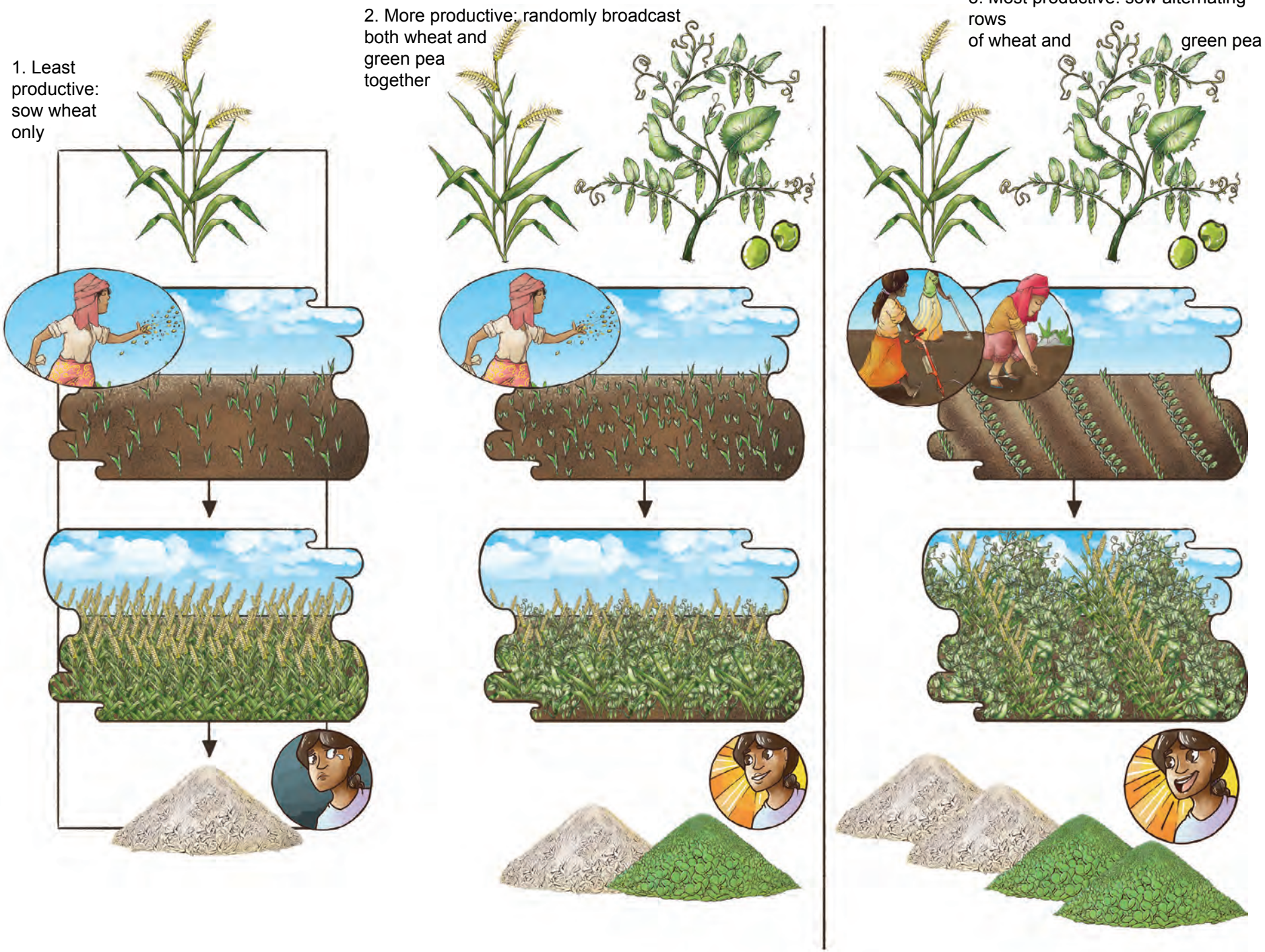
3. Most productive: sow alternating rows of finger millet and blackgram



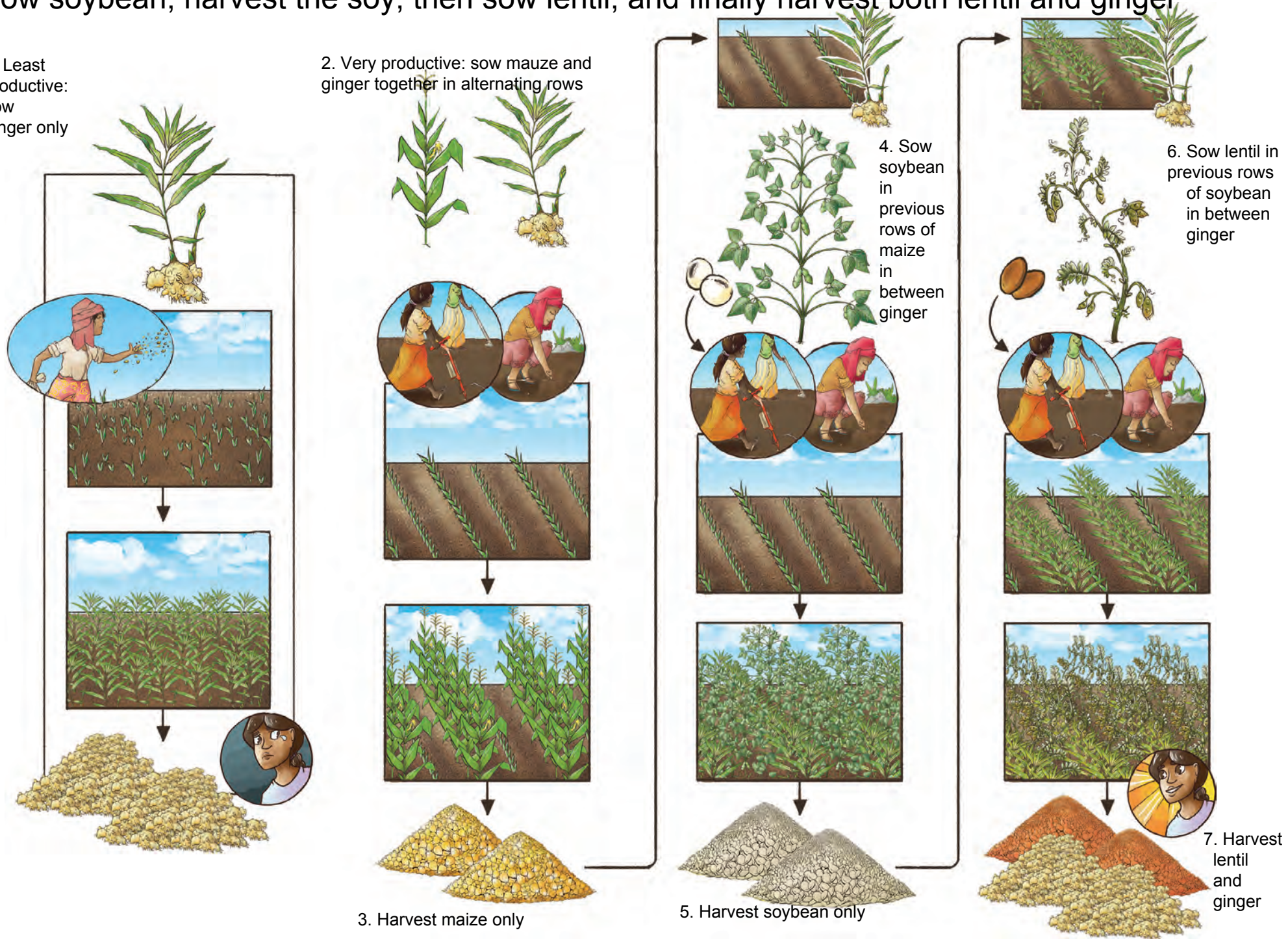
Lesson: Sowing mustard together with green pea (field pea) will yield more profit than mustard only.



Lesson: Sowing wheat together with green pea (field pea) will yield more profit than wheat only.



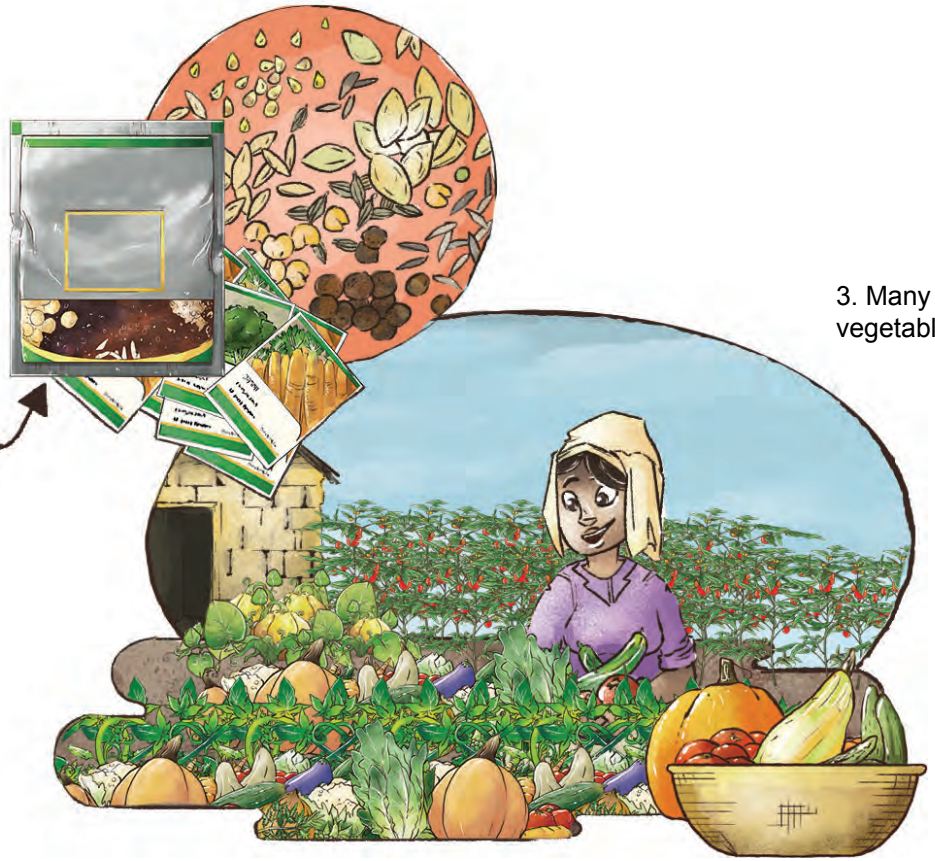
Lesson: Compared to sowing only ginger, it is more profitable to also sow maize, harvest the maize, then sow soybean, harvest the soy, then sow lentil, and finally harvest both lentil and ginger



Lesson: A kit of seed packages will increase the types of fruits and vegetables in the garden

1. Traditional: only few types of vegetables

2. New practice: purchase packages of different seeds (composite seed package)

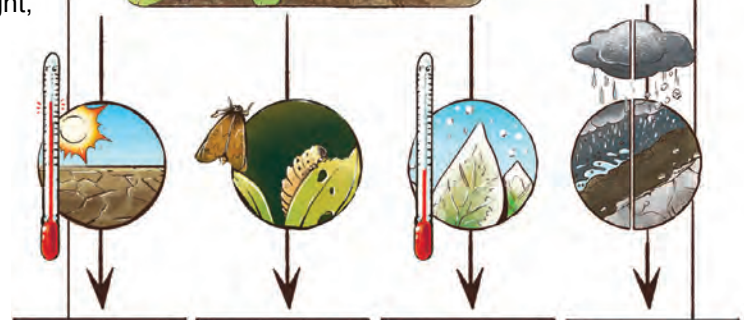


3. Many types of vegetables

Lesson: A greenhouse (plastic tunnel) can improve vegetable production

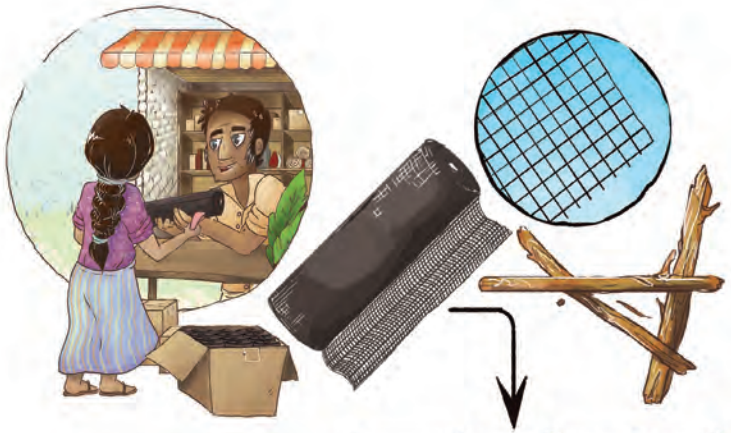
1. Traditional practice: vegetables uncovered

2. Drought, insects, cold or heavy rain damage crops



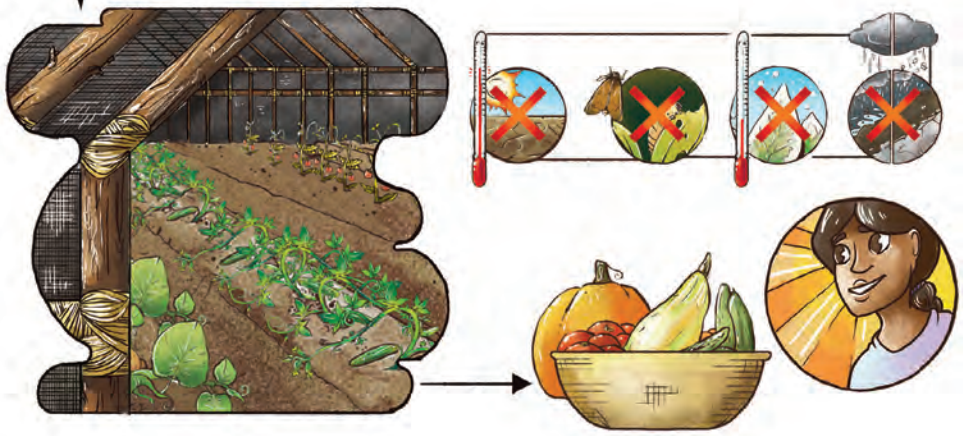
3. Low yield

4. New practice: purchase mesh (if hot such as in tropics)



5. Build greenhouse (high tunnel)

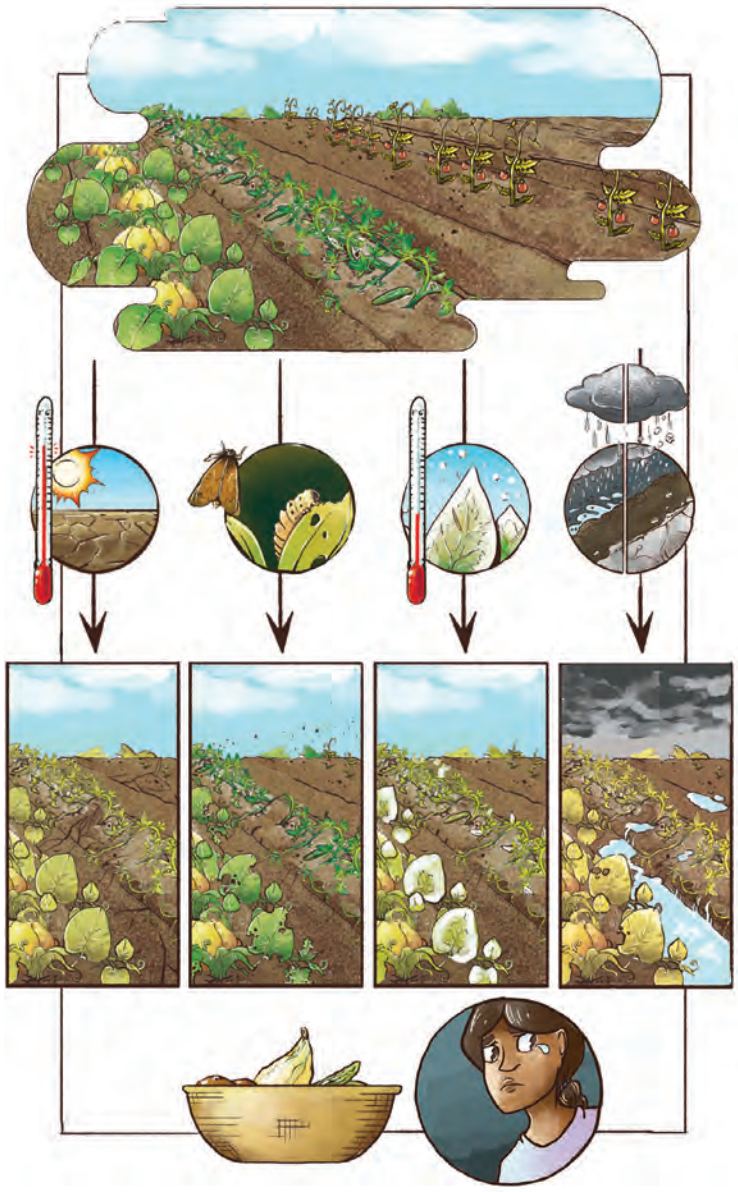
6. Vegetables are protected from drought, insects, cold or heavy rain



7. High yield

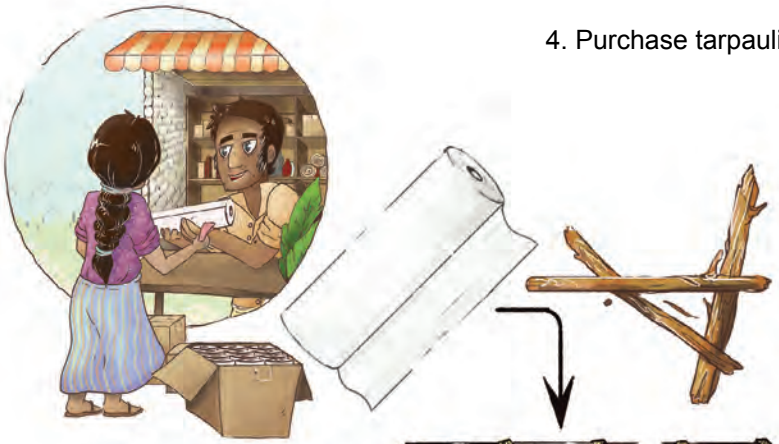
Lesson: A greenhouse (plastic tunnel) can improve vegetable production

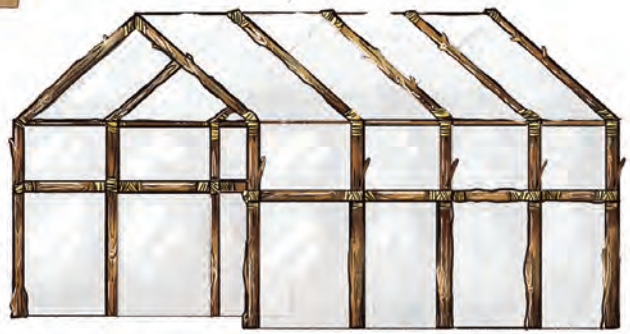
1. Traditional practice: vegetables uncovered



3. Low yield

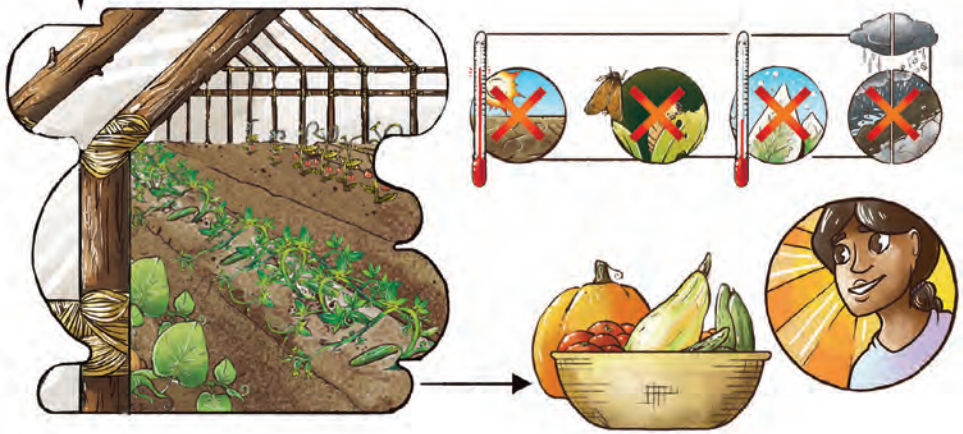
4. Purchase tarpaulin (in colder climate)





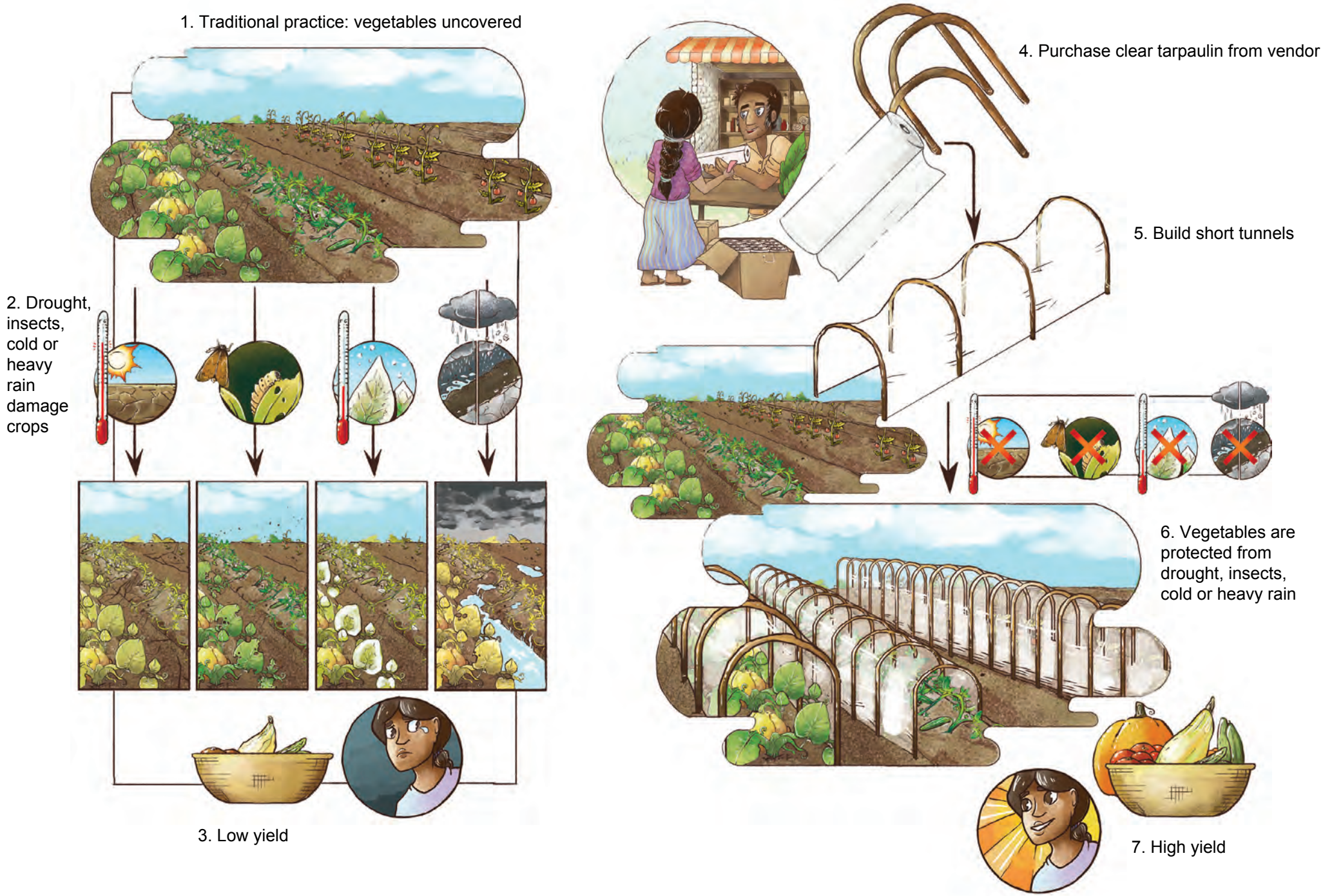
5. Build greenhouse (high tunnel)

6. Vegetables are protected from drought, insects, cold or heavy rain

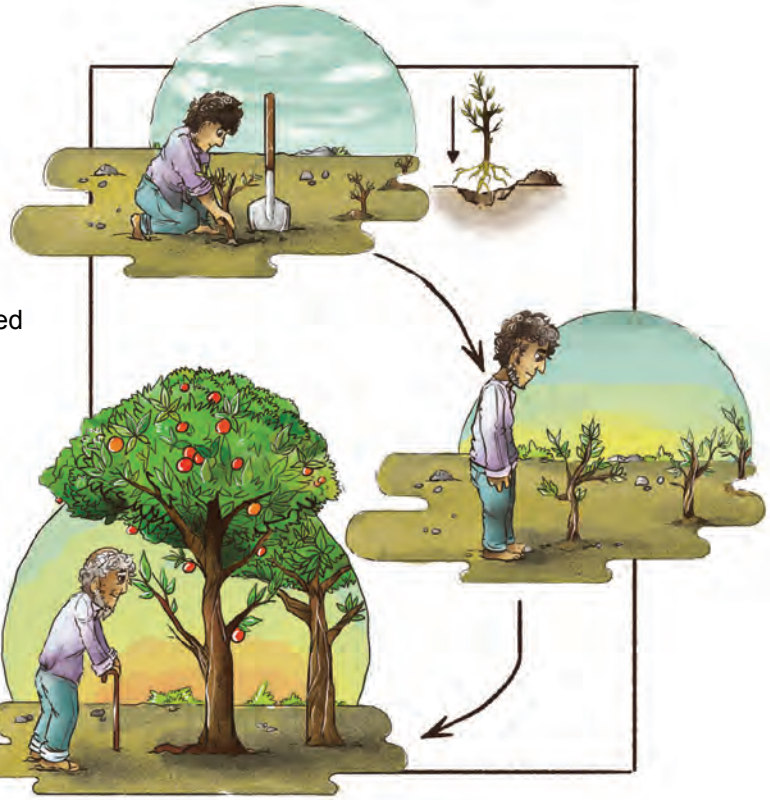


7. High yield

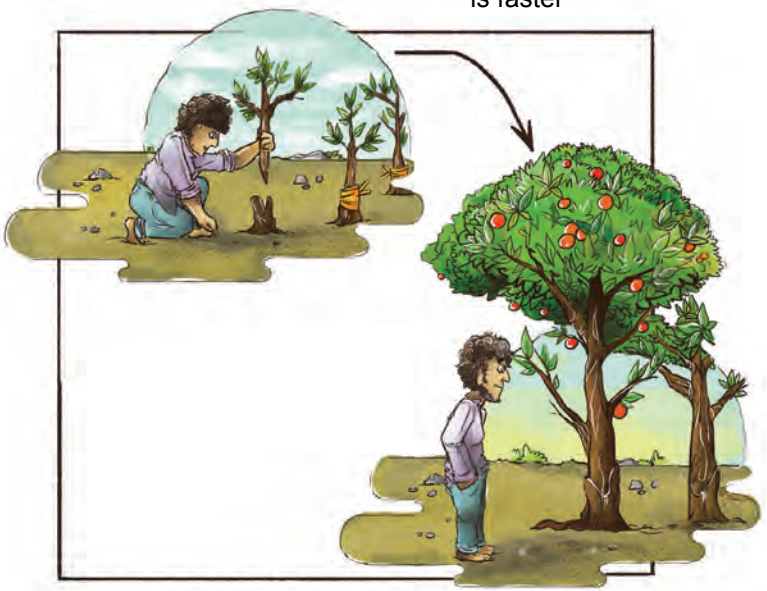
Lesson: Low tunnel covers can help to grow vegetables (should combine with drip irrigation or else use mesh material)



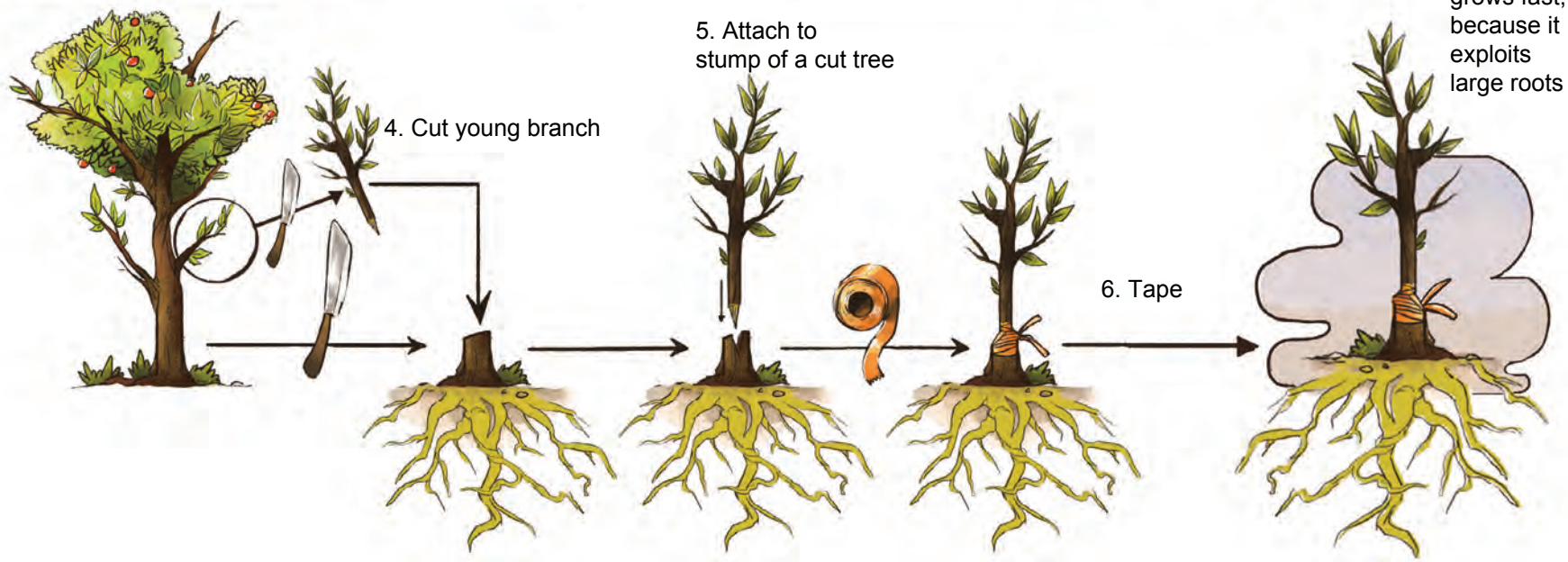
Lesson: Grow a new tree much faster by attaching a young branch onto an old tree stump



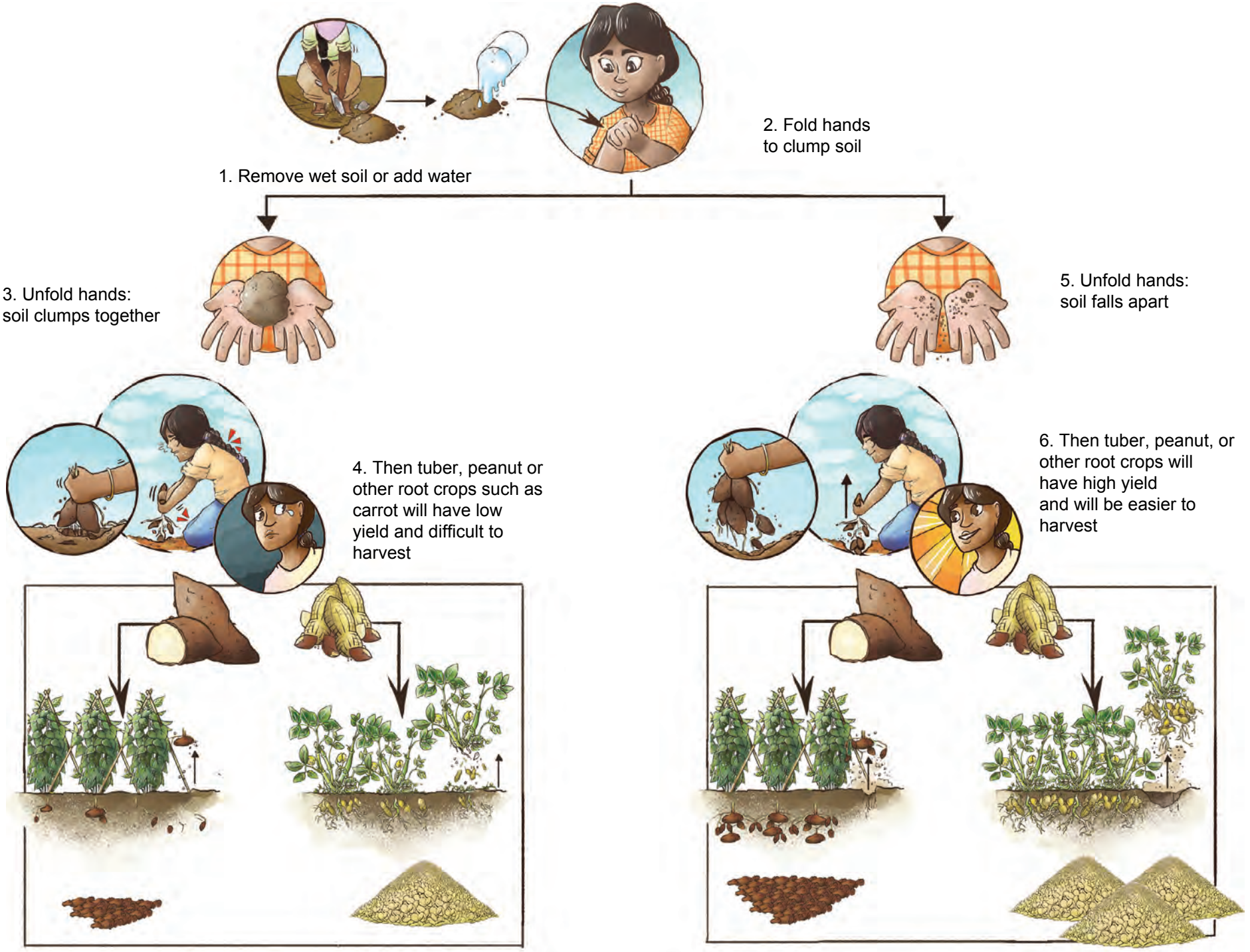
1. Traditional practice: planting tree from sapling or seed is slow



2. New practice: attaching young branch to old tree stump is faster

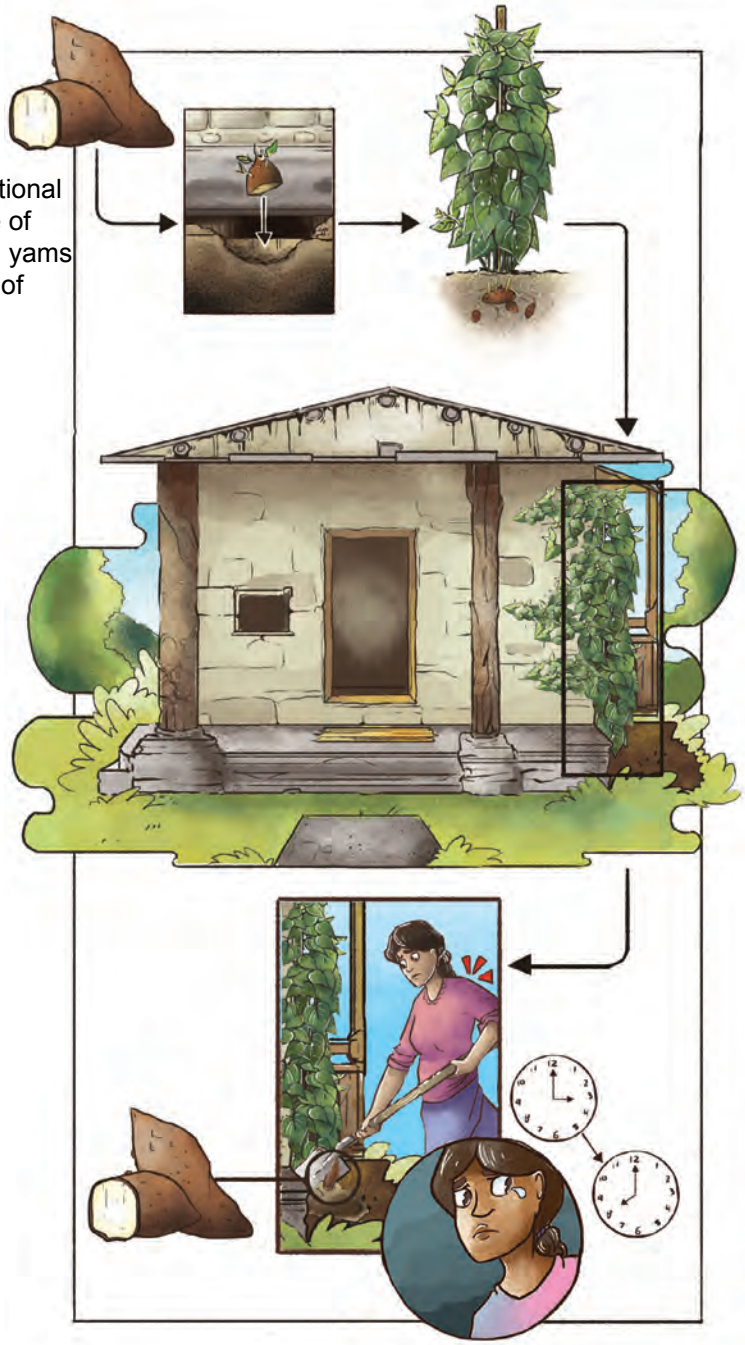


Lesson: A simple soil clumping test can help determine whether root crops can be grown



Chapter 4: **Terrace Agriculture**

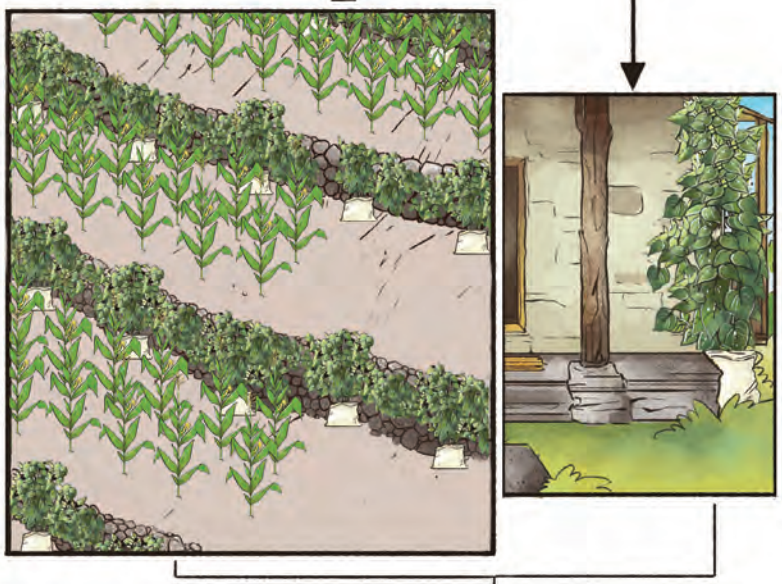
Lesson: Yams or tubers planted in sacks at the base of the terrace wall will reduce labour at the time of harvesting and increase the usage of the terrace wall.



1. Traditional practice of growing yams on side of house

2. Difficult to dig to harvest yams/tubers

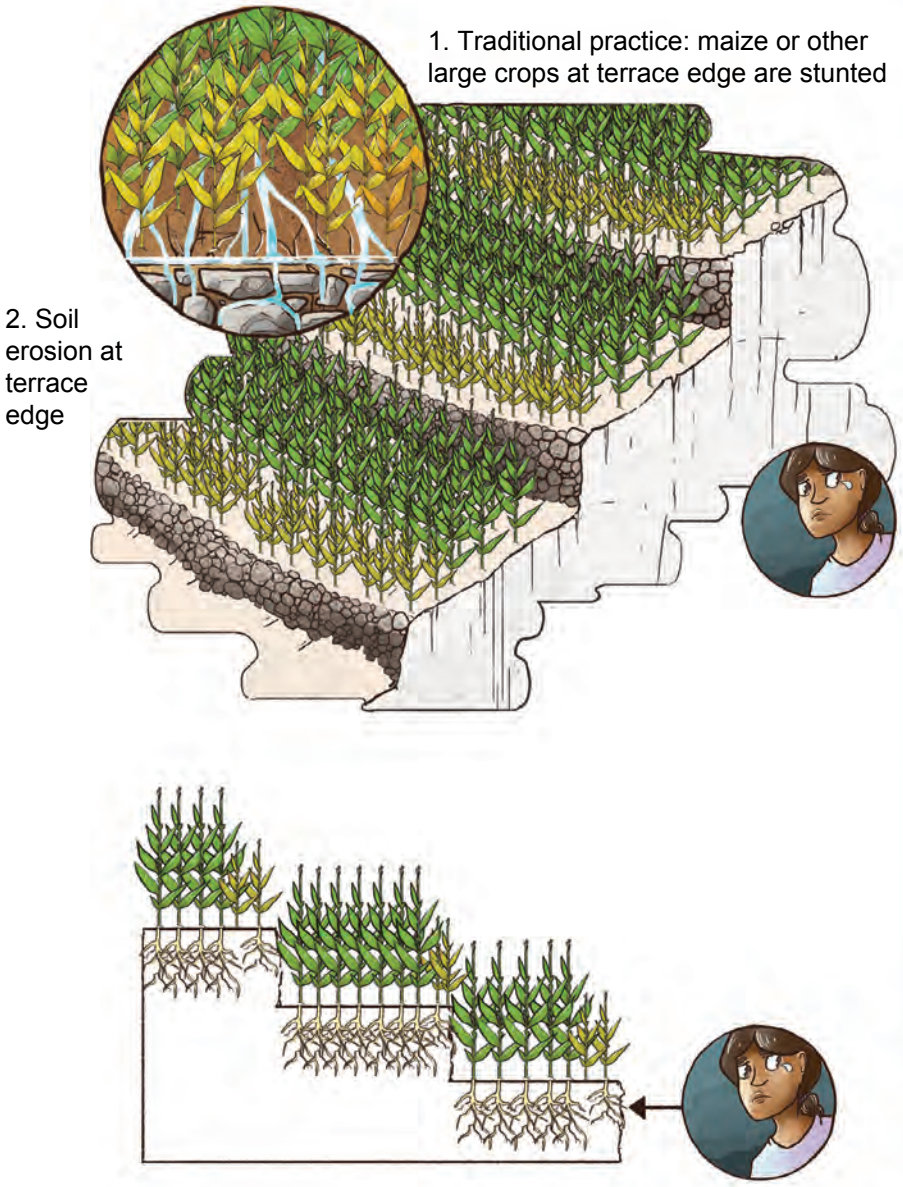
3. New practice: place yam seed in bag with soil



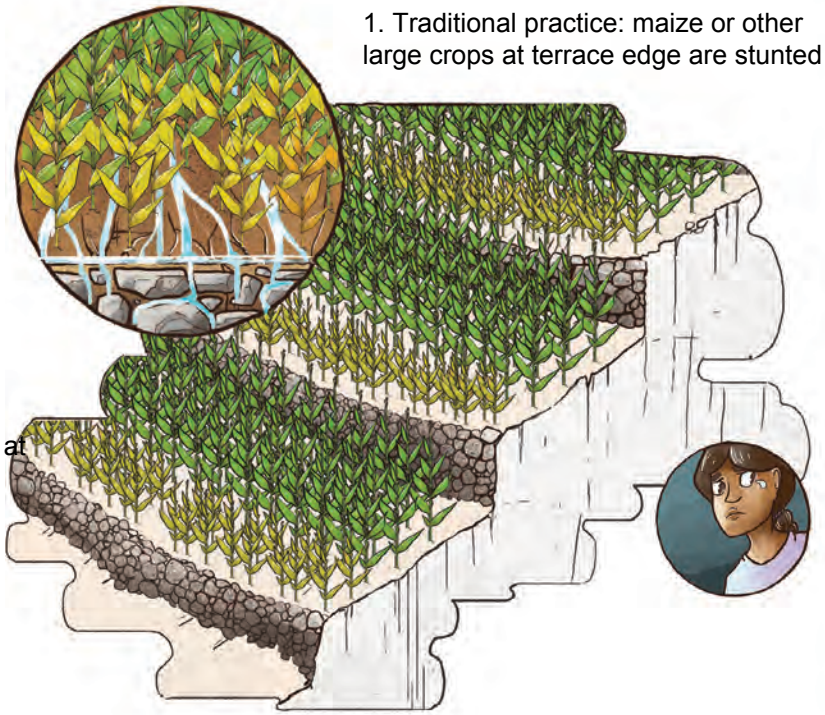
4. Place bags at bottom of terrace wall

5. Easy to harvest yam from bags

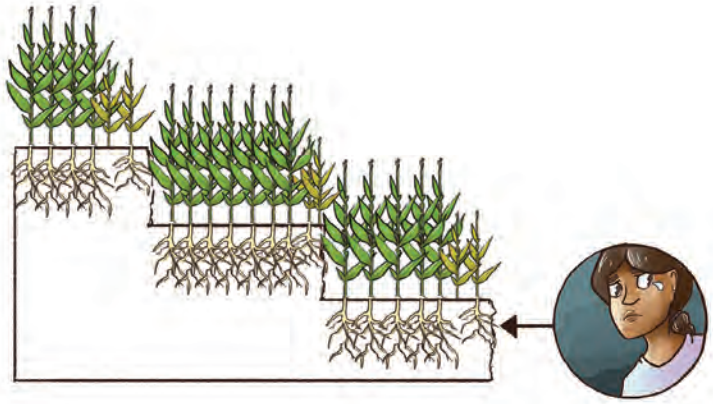
Lesson: Climbing beans can be planted at the base of the terrace wall for growth up the wall to maximize usage of the vertical surface area.



1. Traditional practice: maize or other large crops at terrace edge are stunted

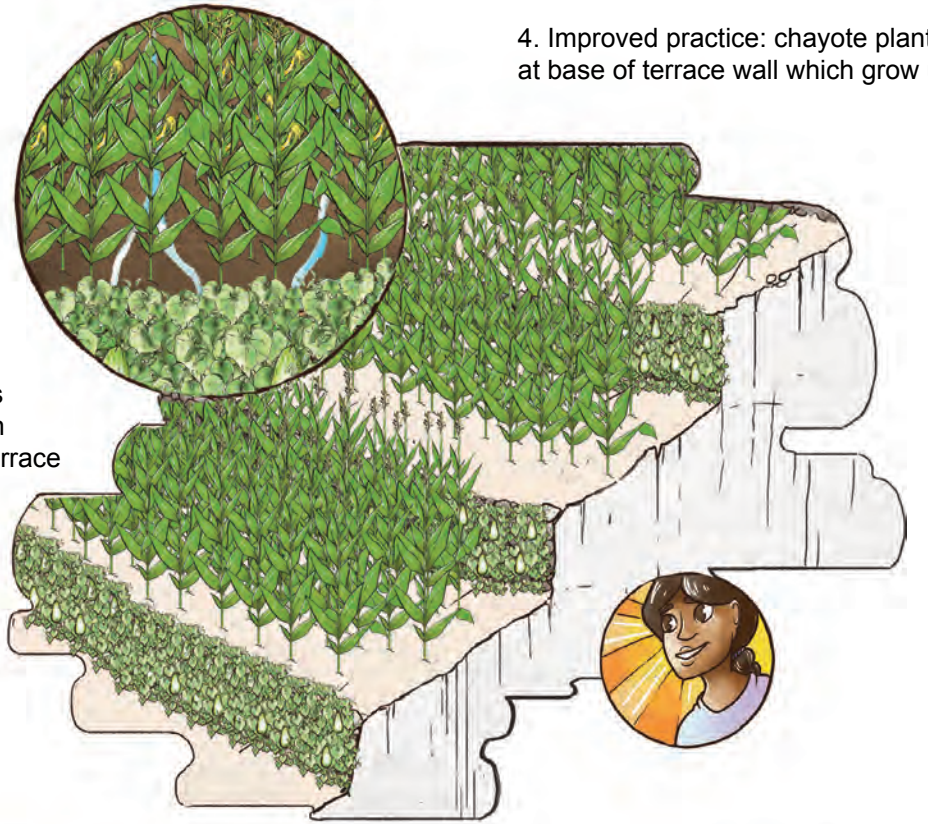


2. Soil erosion at terrace edge

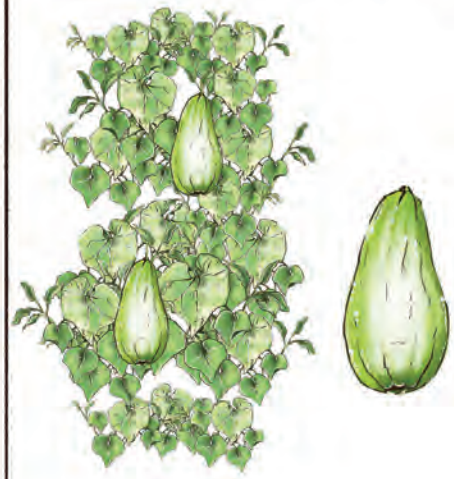


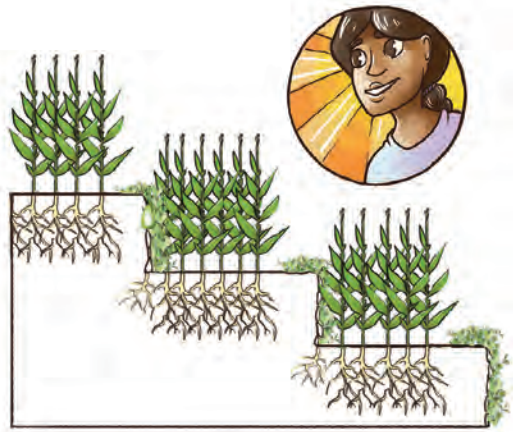
3. Traditionally, low yield near terrace edge

4. Improved practice: chayote planted at base of terrace wall which grow up



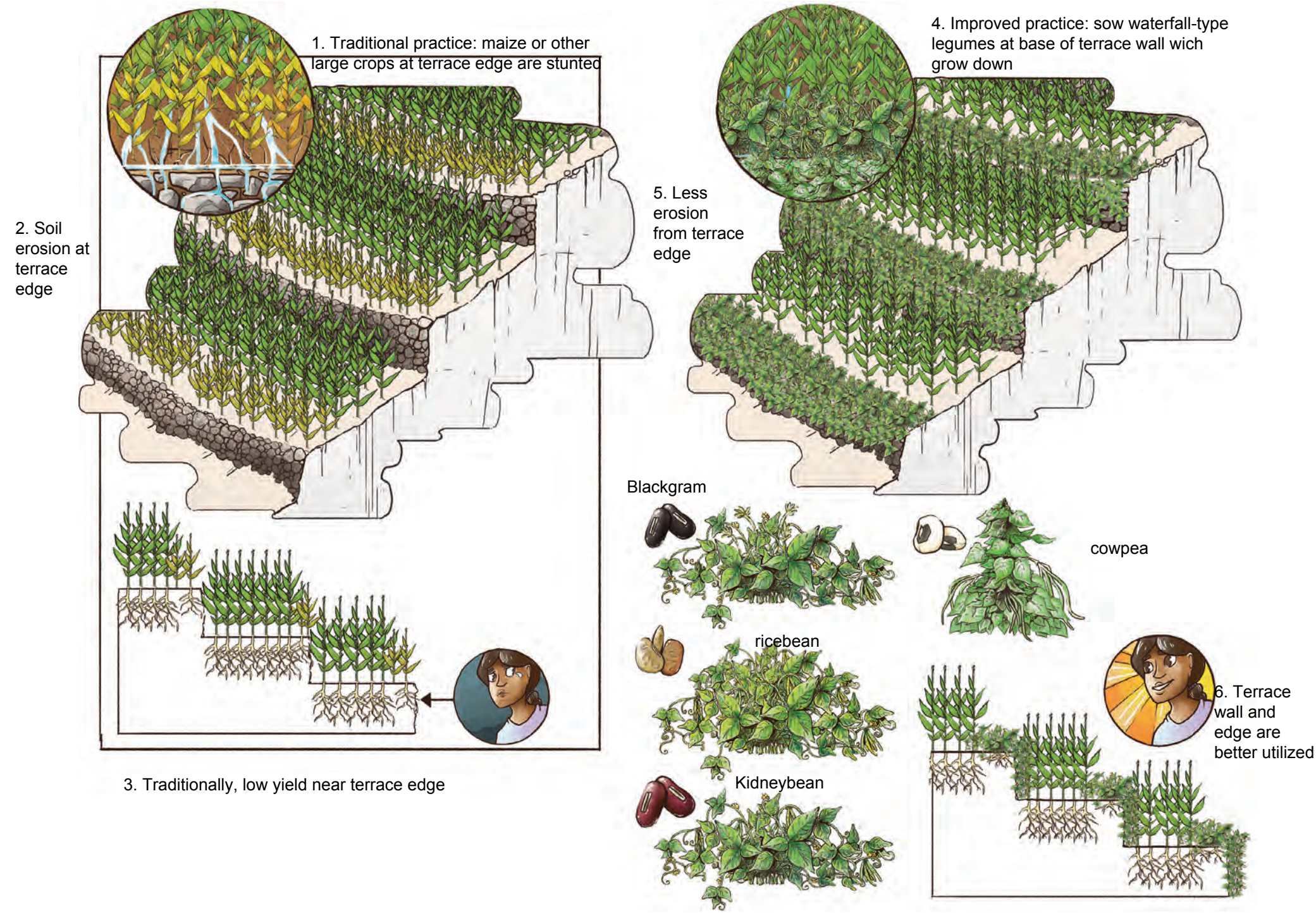
5. Less erosion from terrace edge



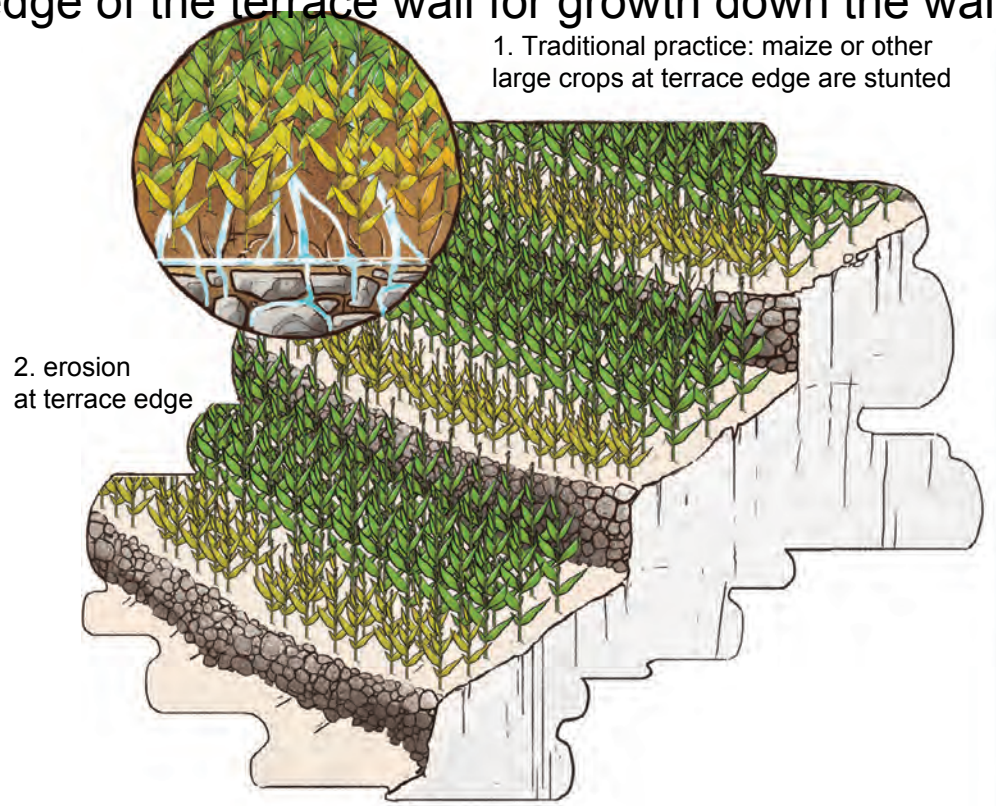


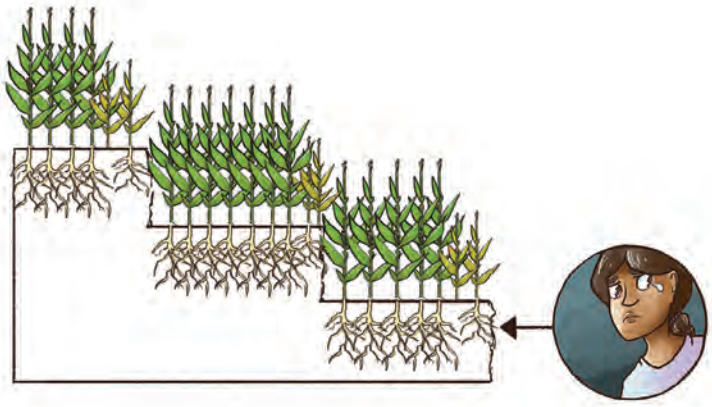
6. Terrace wall is better utilized

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

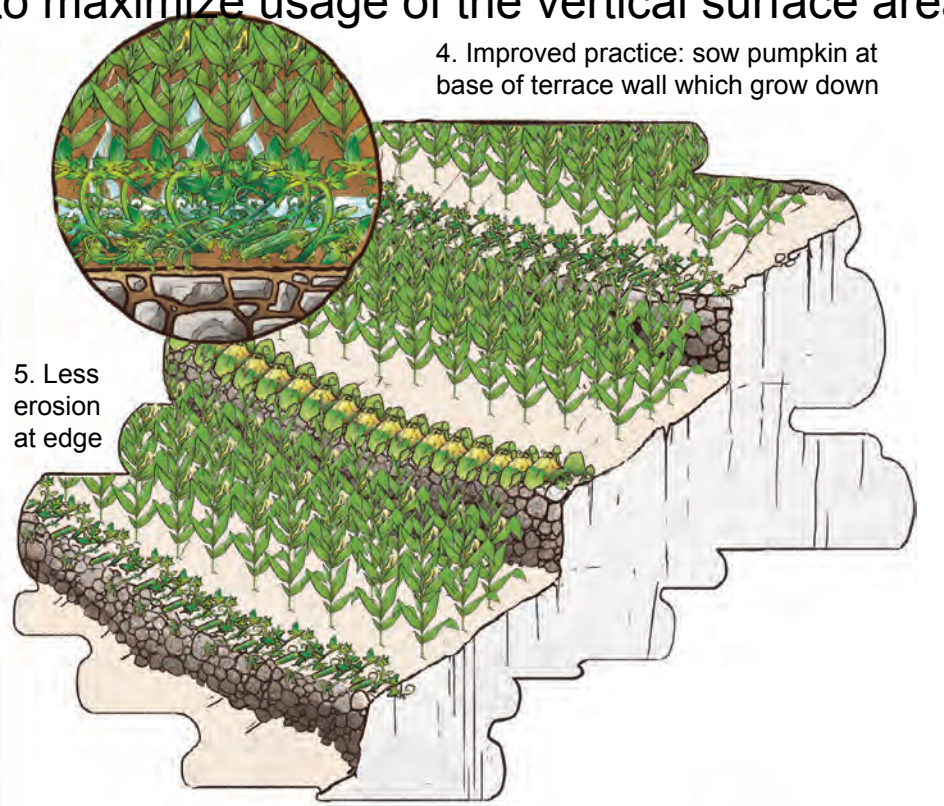


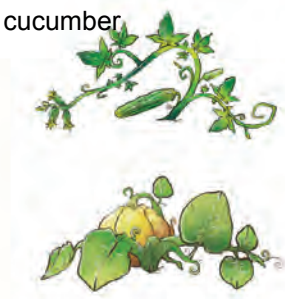
Lesson: Waterfall-type cucurbits (pumpkin, cucumber, squash, melon) can be planted at the top edge of the terrace wall for growth down the wall to maximize usage of the vertical surface area.

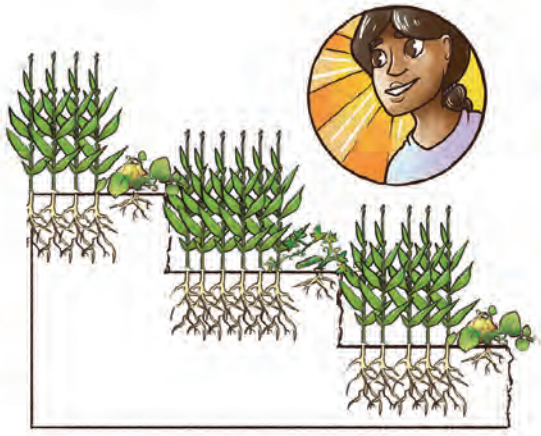




3. Traditionally, low yield near terrace edge



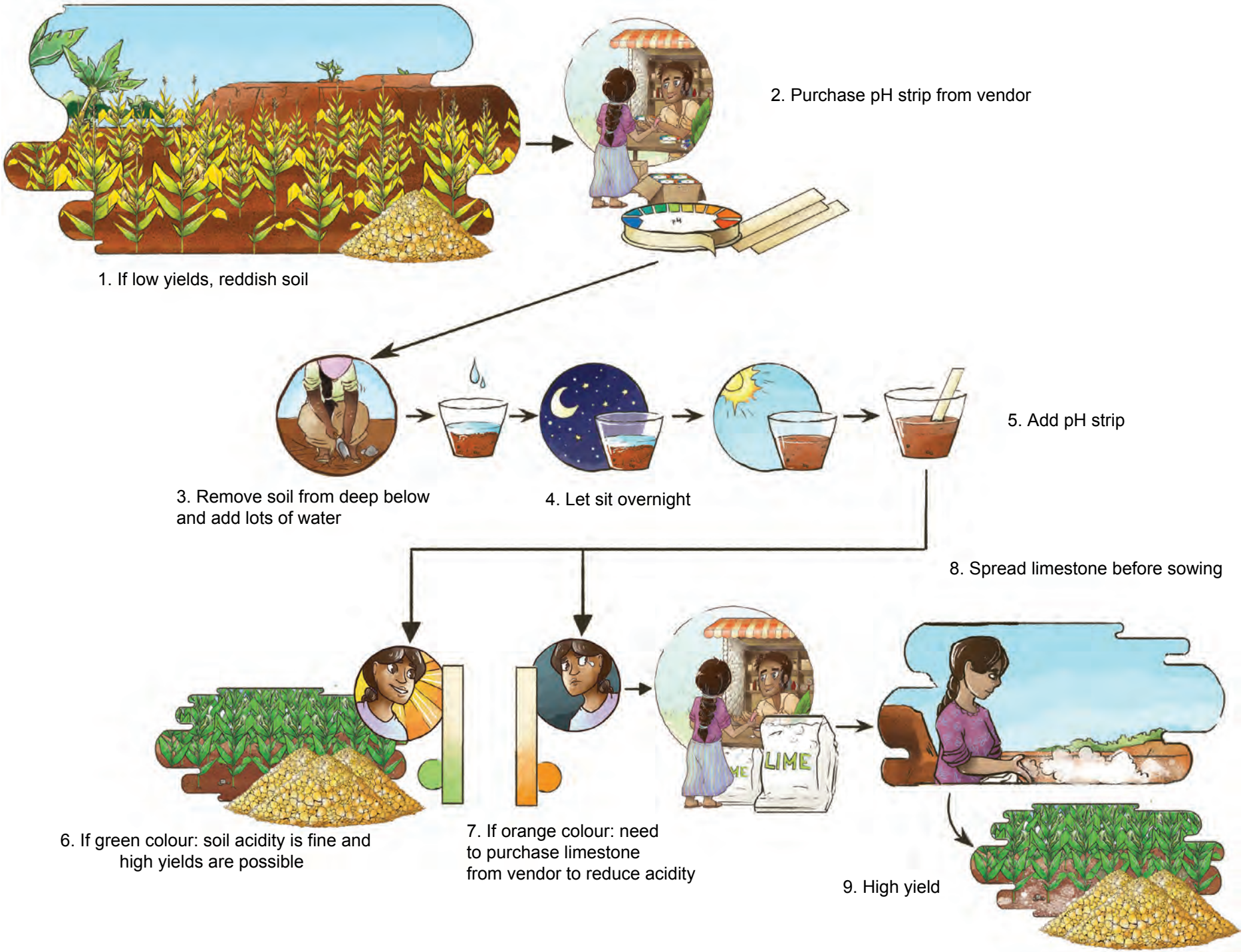




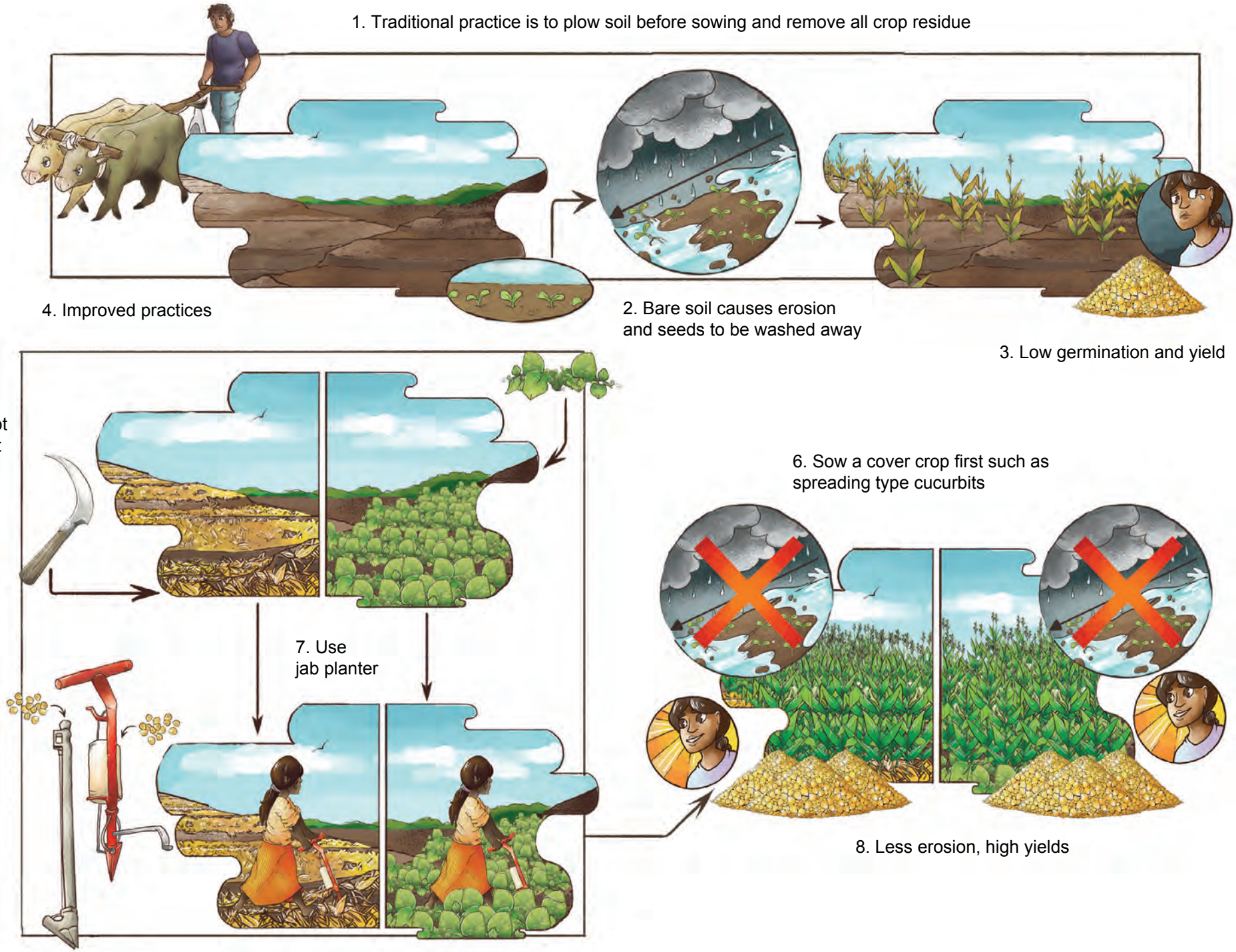
6. Terrace wall and edge are better utilized

Chapter 5: **Soil Health**

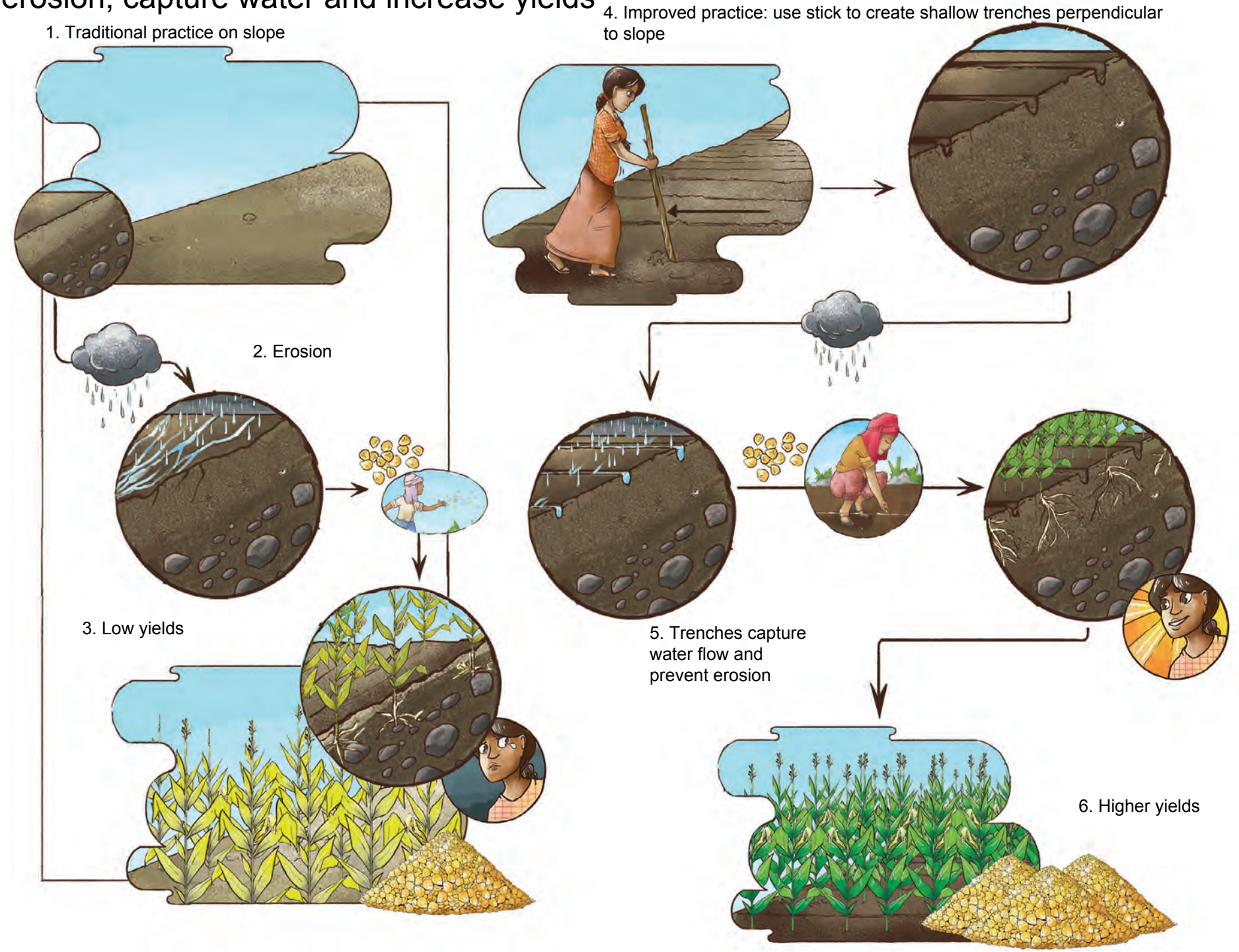
Lesson: If yields are low and the soil is reddish, soil acidity should be tested



Lesson: Not leaving the soil bare reduces soil erosion and improves yields

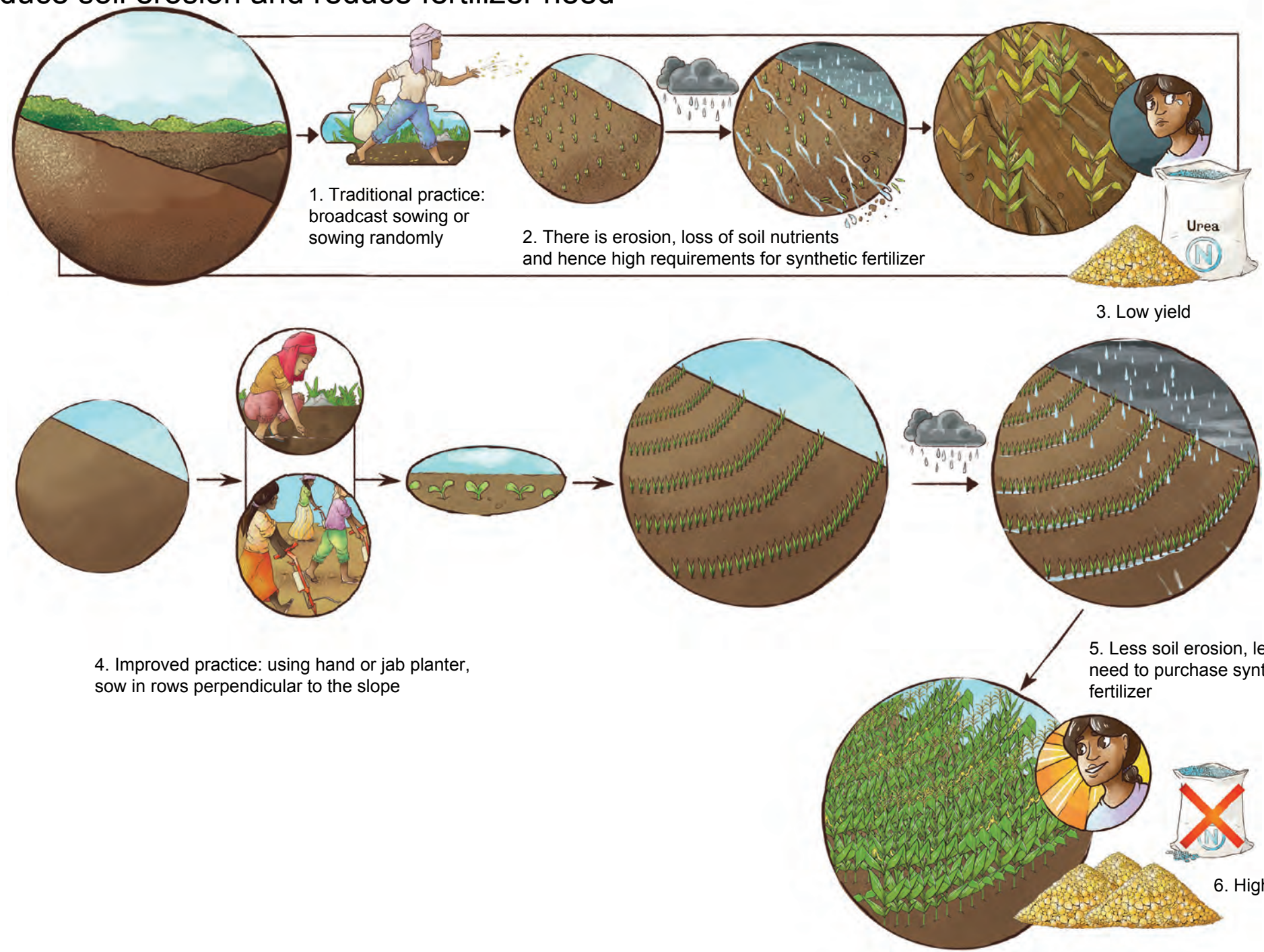


Lesson: Creating shallow trenches with a stick perpendicular to a slope will reduce soil erosion, capture water and increase yields

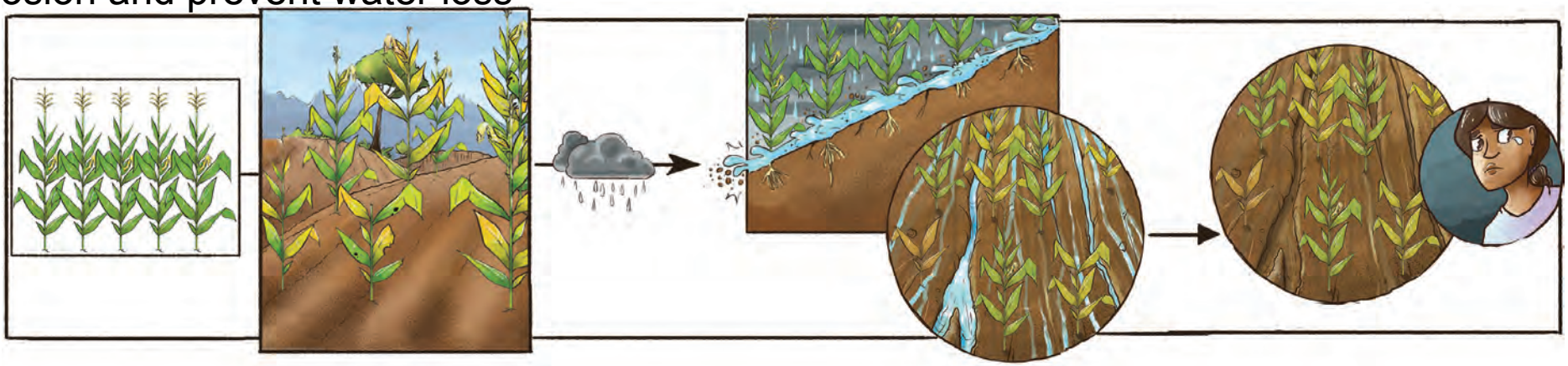


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: On non-terraced, sloped land, sowing crops in rows perpendicular to the slope will reduce soil erosion and reduce fertilizer need

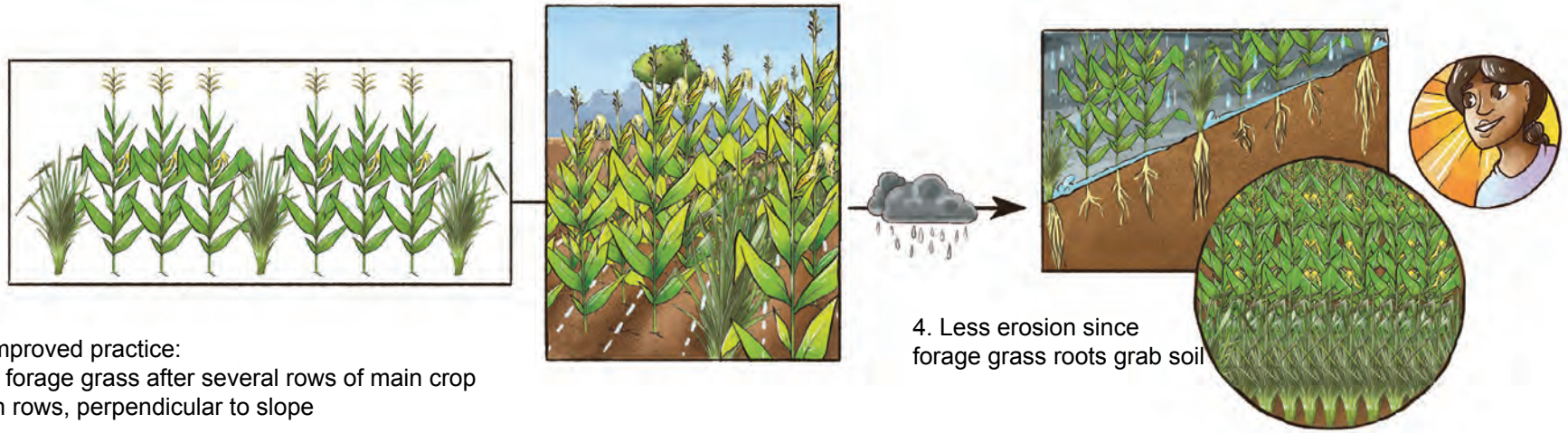


Lesson: On sloped, non-terraced land, sowing vetiver or other forage grasses will reduce erosion and prevent water loss



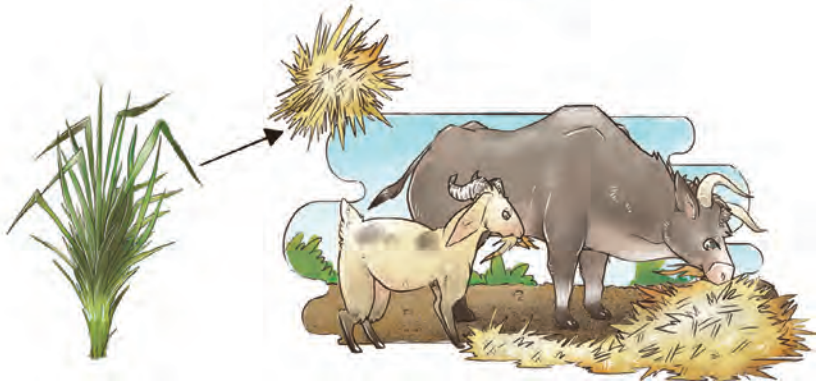
1. Traditional practice

2. Erosion



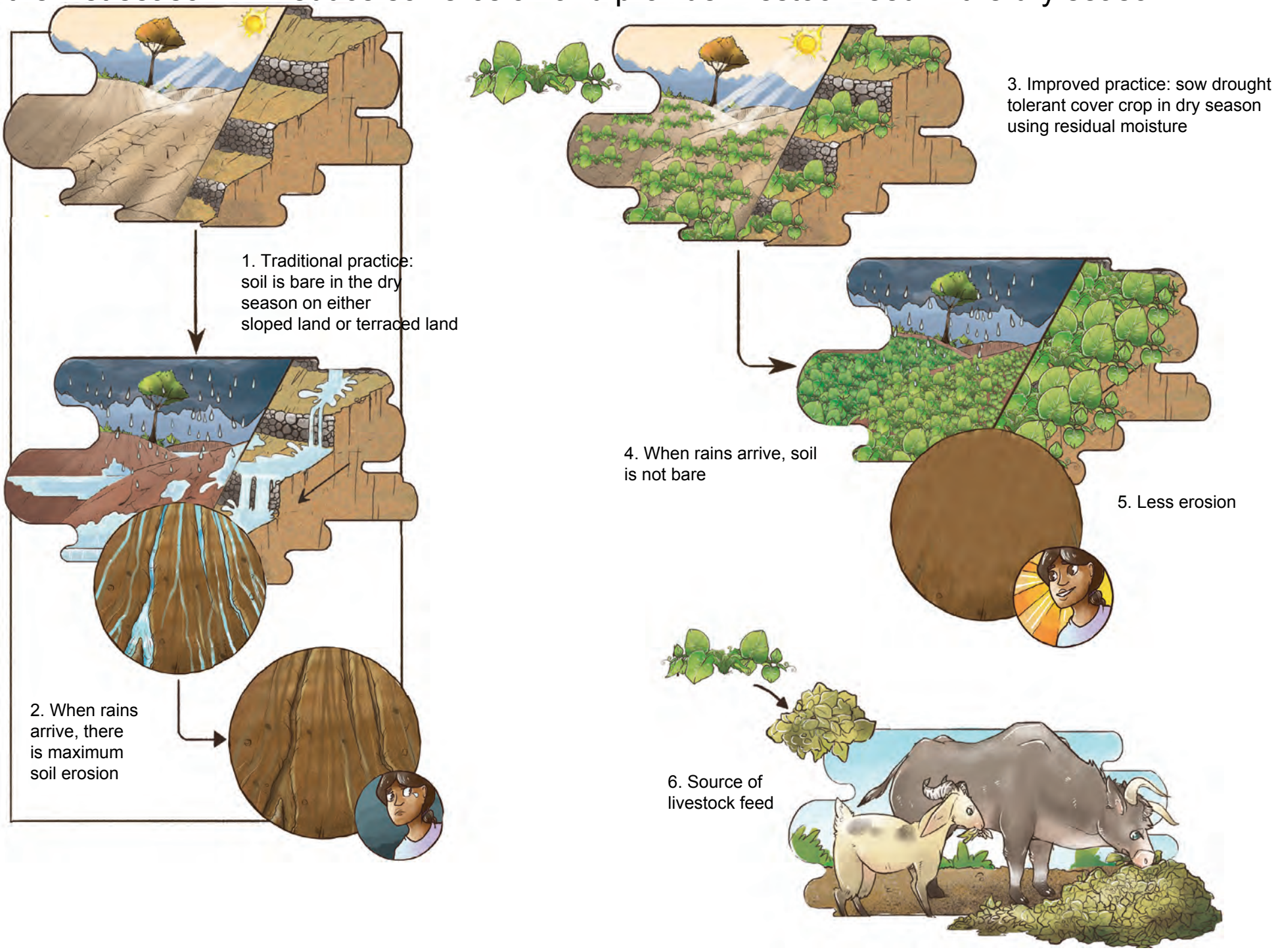
3. Improved practice:
sow forage grass after several rows of main crop
all in rows, perpendicular to slope

4. Less erosion since
forage grass roots grab soil

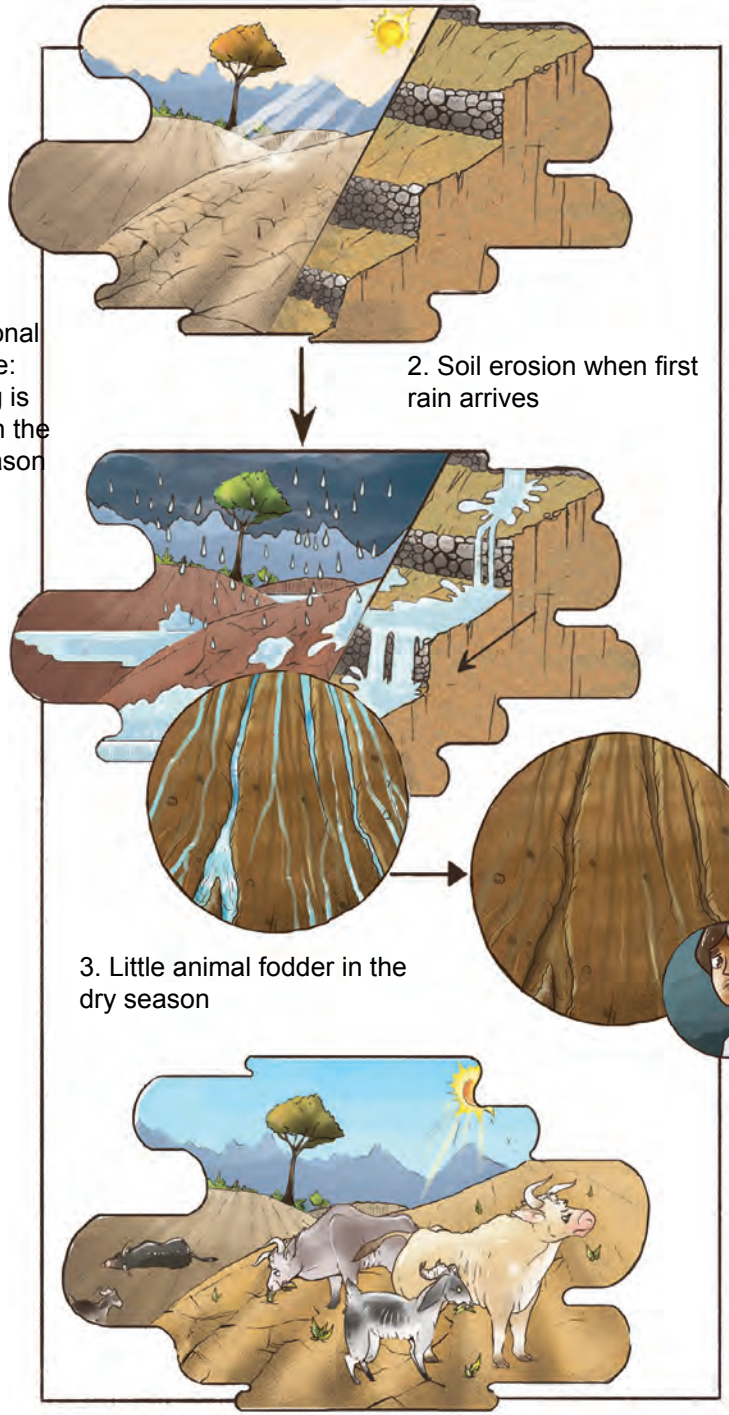


5. Forage grass can be fed to livestock

Lesson: Sowing a spreading type cover crop prior to the transition between the dry season and the wet season will reduce soil erosion and provide livestock feed in the dry season



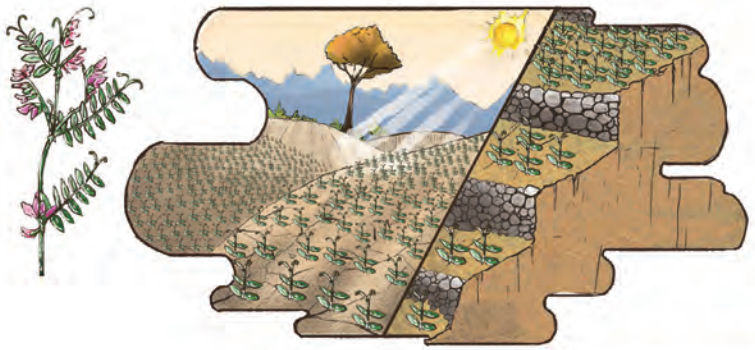
Lesson: Planting vetch in the dry season will reduce soil erosion, provide animal fodder and add nutrients to soil.



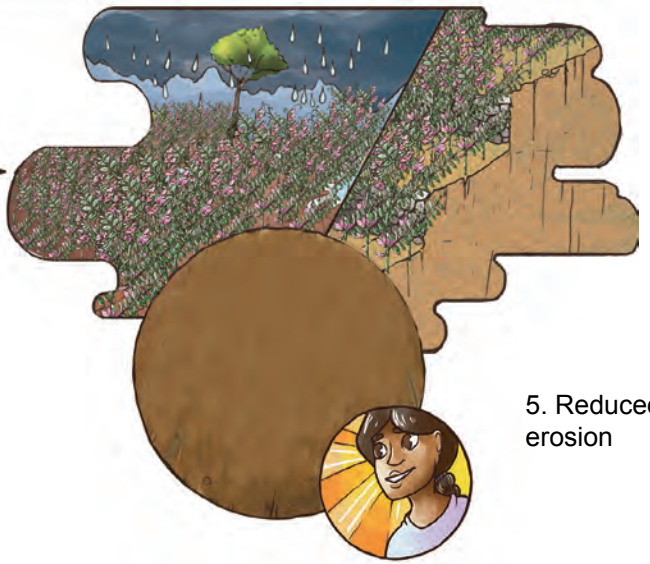
1. Traditional practice: nothing is sown in the dry season

2. Soil erosion when first rain arrives

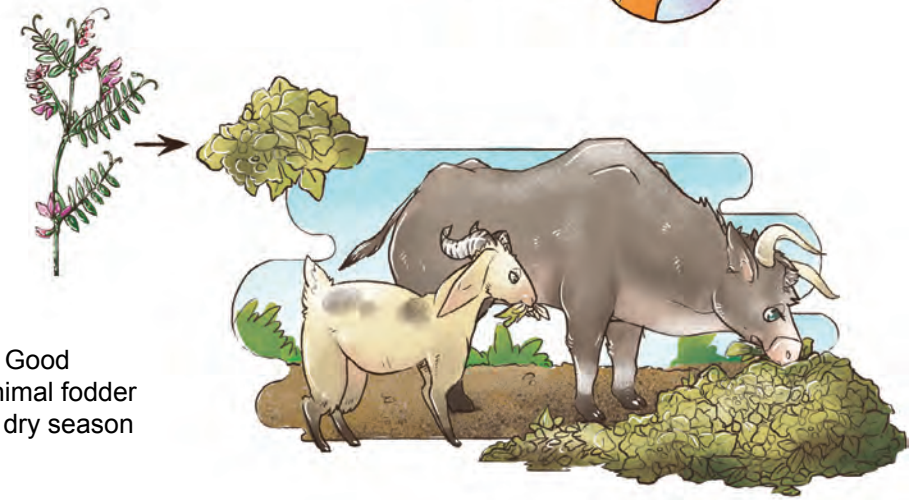
3. Little animal fodder in the dry season



4. Improved practice: sow vetch prior to the beginning of the rainy season

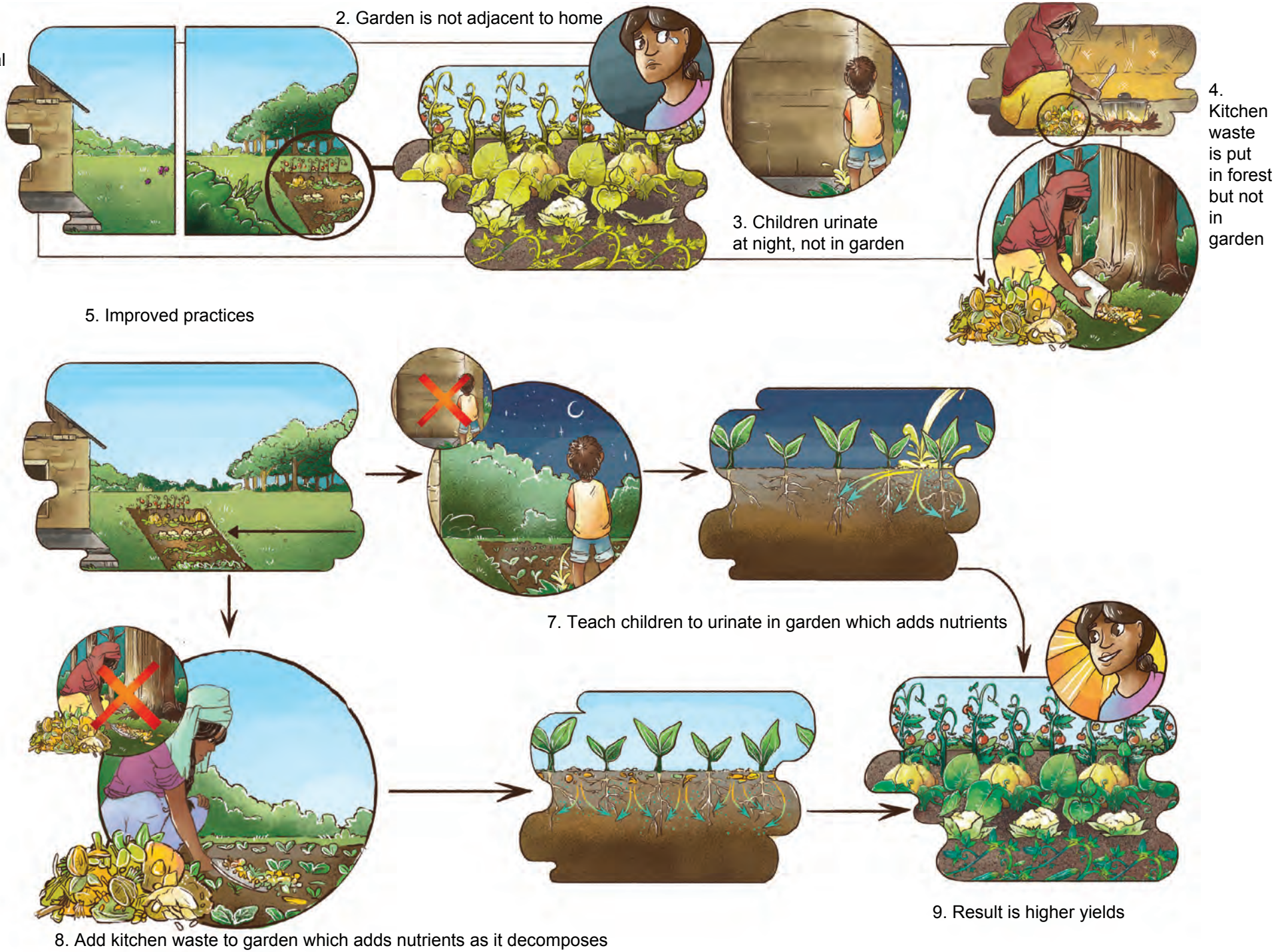


5. Reduced erosion

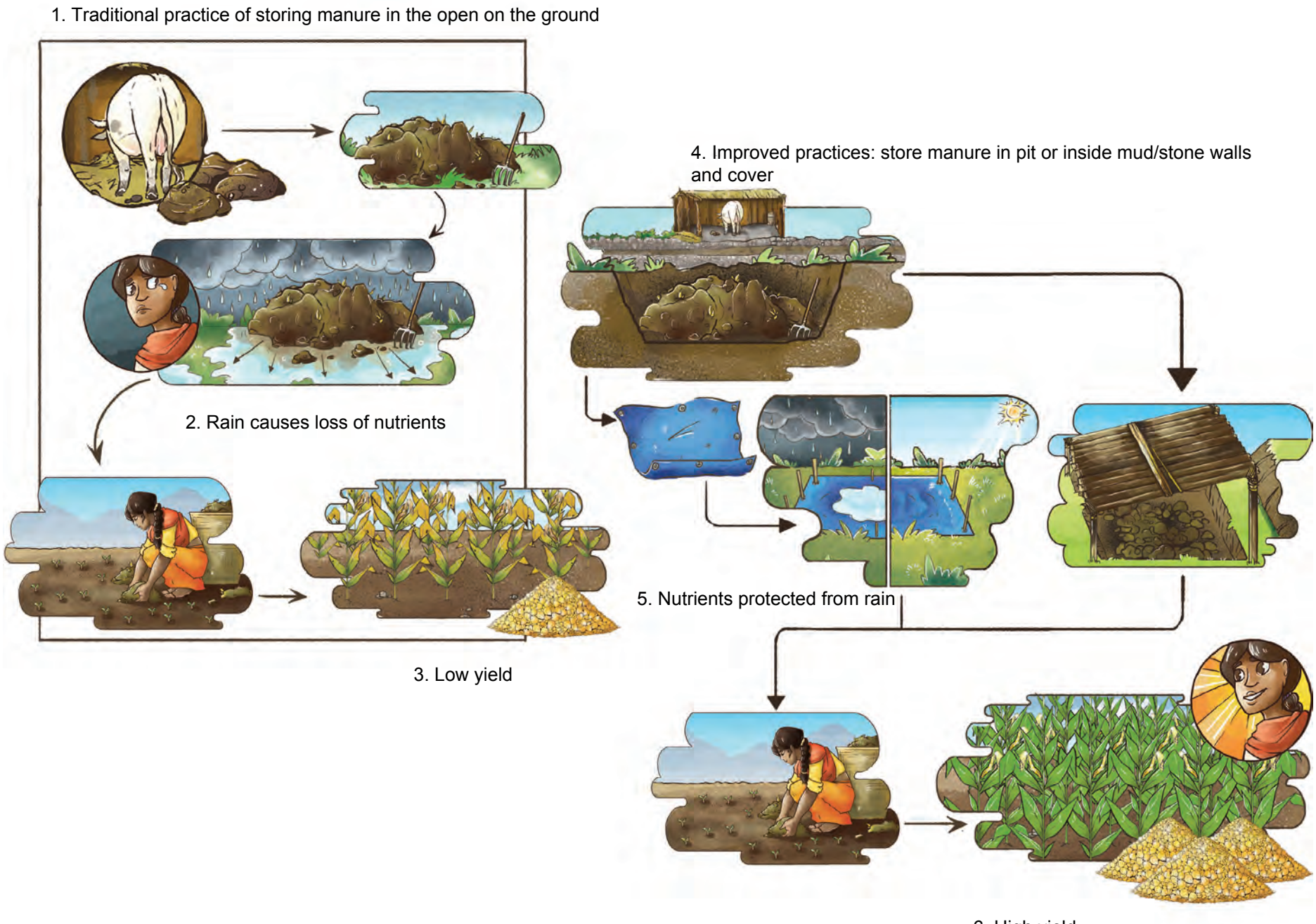


6. Good animal fodder in dry season

Lesson: Simple practices can improve yields of home gardens

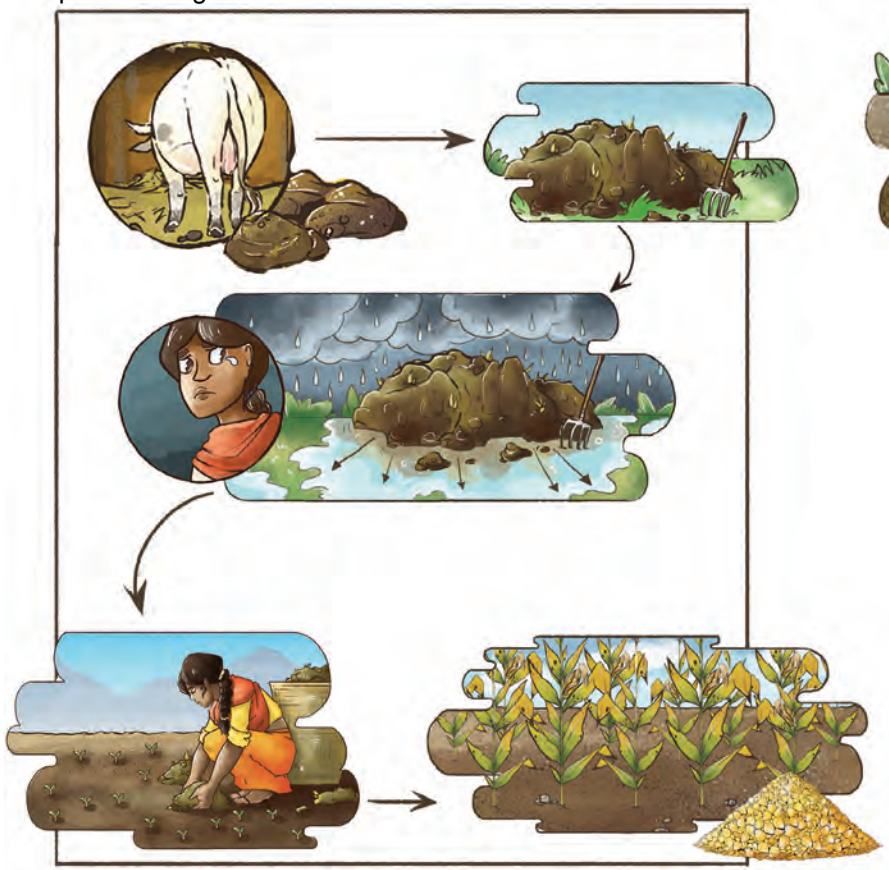


Lesson: Covering manure from rain will prevent loss of its nutrients



Lesson: Covering manure from rain will prevent loss of its nutrients

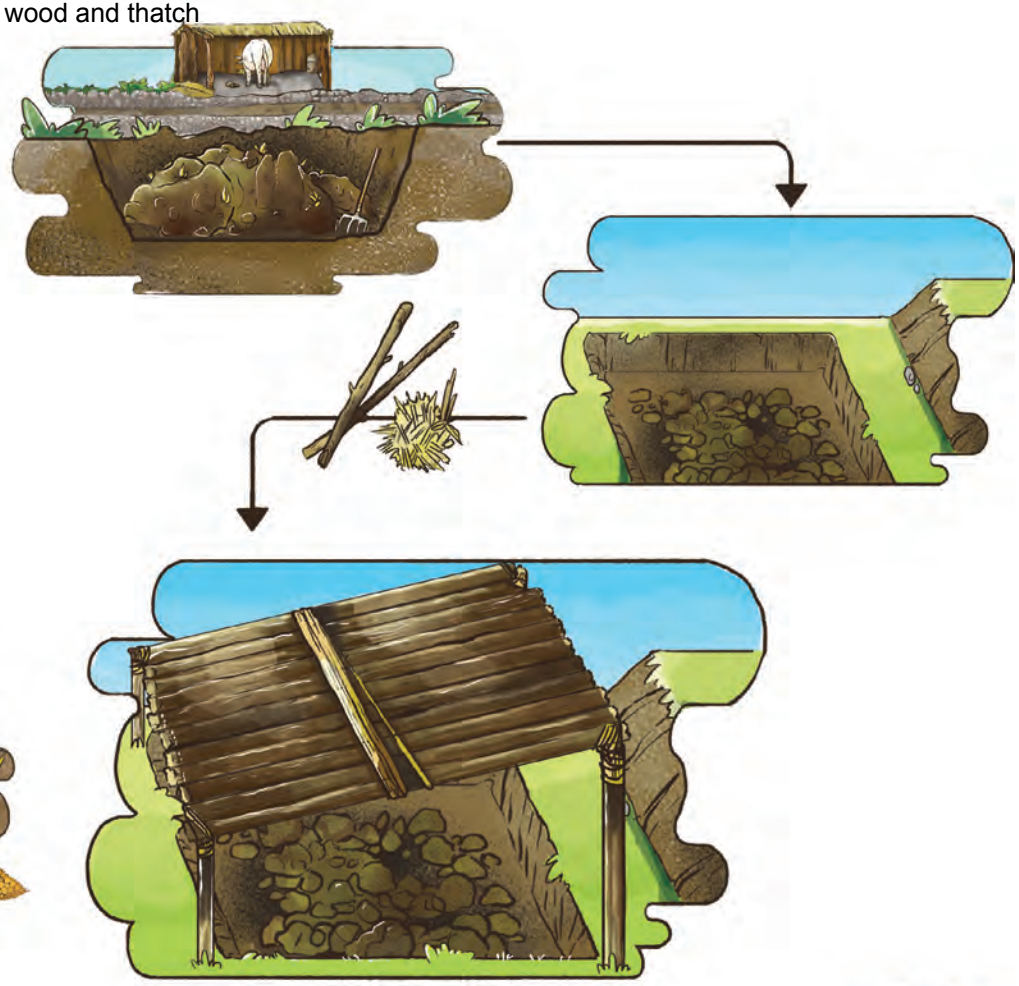
1. Traditional practice of storing manure in the open on the ground



2. Rain causes loss of nutrients

3. Low yield

4. Improved practices: store manure in pit and cover with wood and thatch



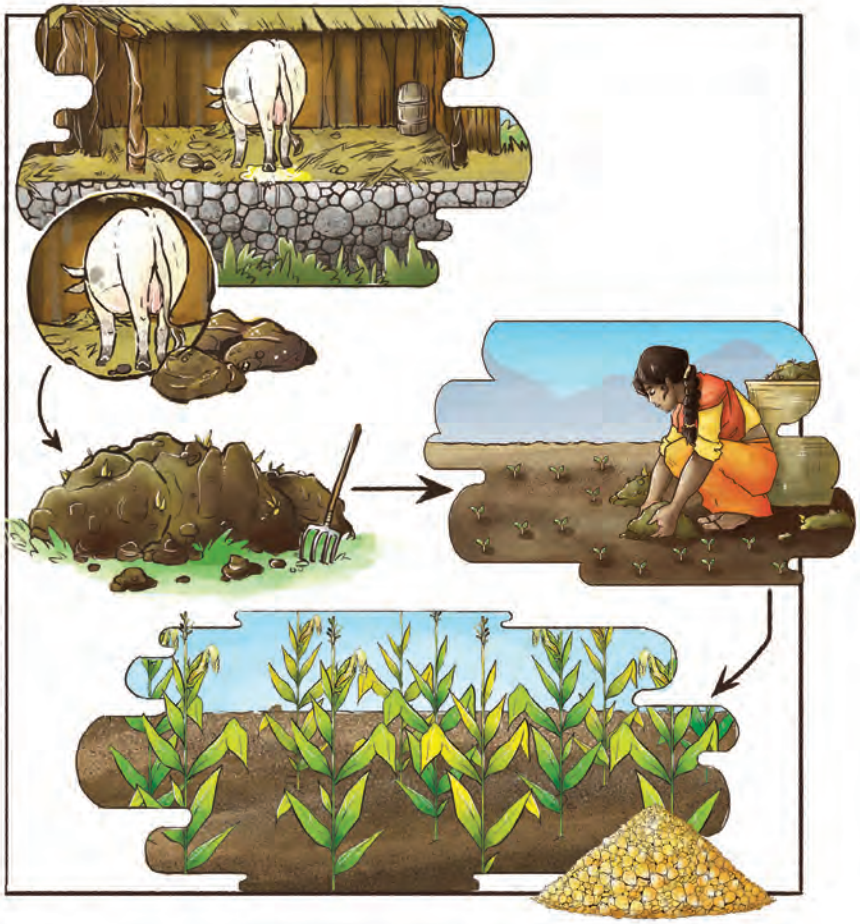
5. Nutrients protected from rain

6. High yield

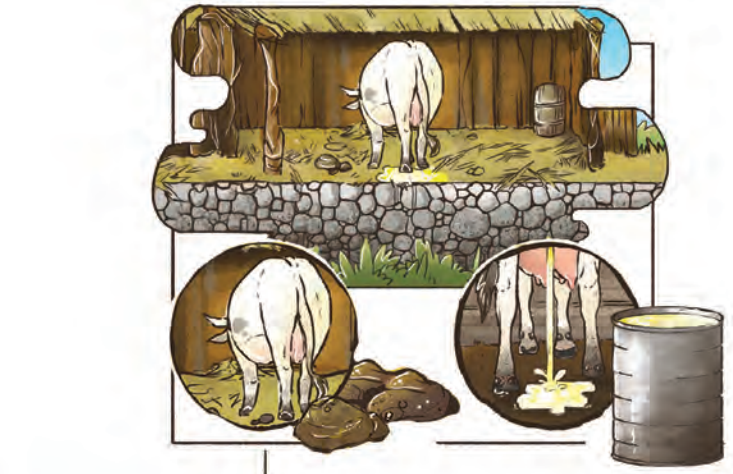
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: There are methods to improve the nutrients of manure (Part 1)

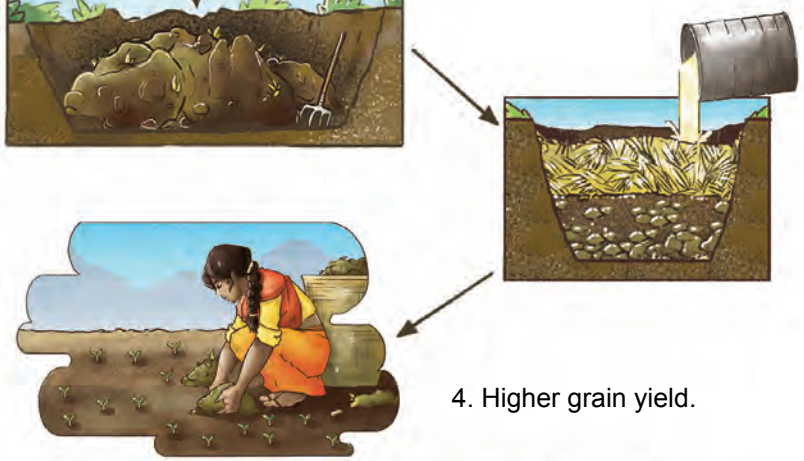
1. Traditional practice: livestock urine is not collected



2. Manure gives lower grain yield.



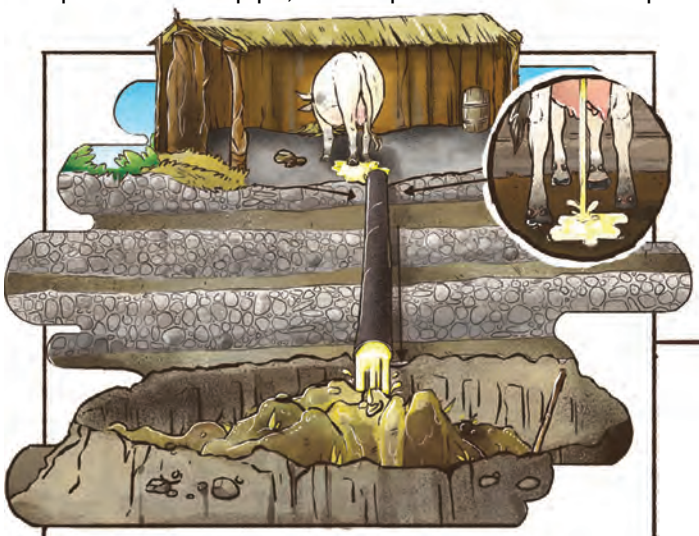
3. New practice: combine urine with manure



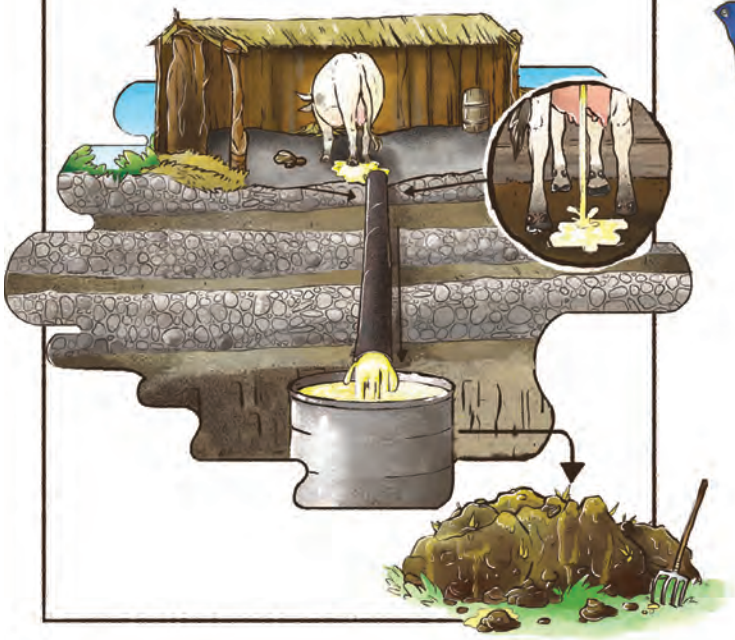
4. Higher grain yield.

Lesson: There are methods to improve the nutrients of manure (Part 2)

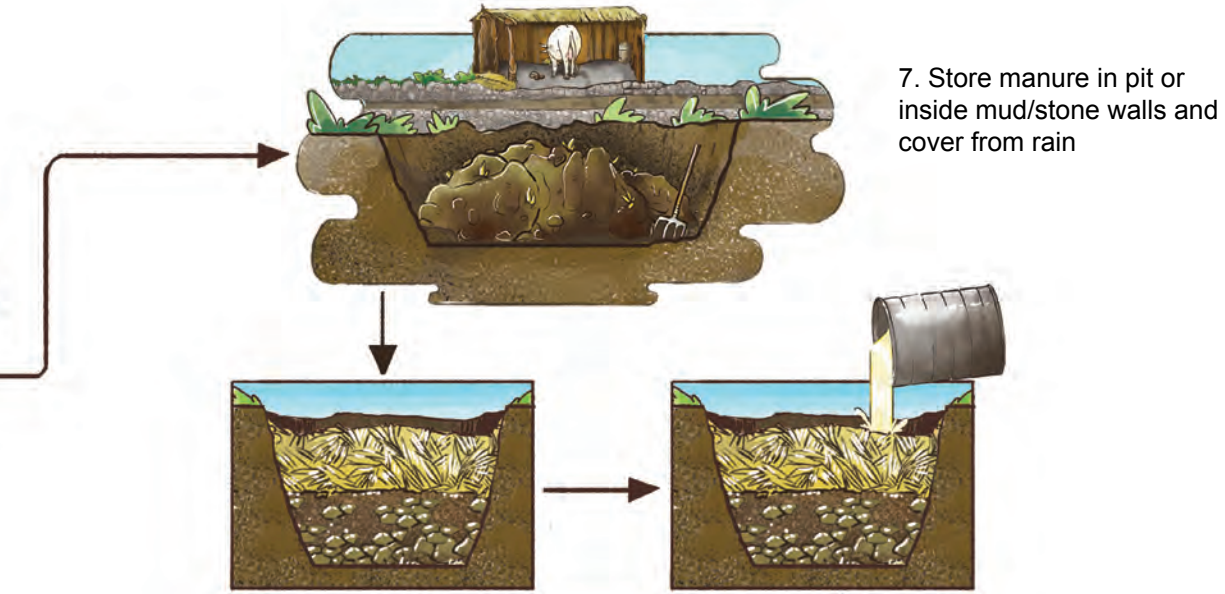
5. Collect urine by using concrete floor that is sloped towards a pipe, and empties into the manure pit.



6. Alternative: urine pipe can go to a drum from which urine can be added to manure

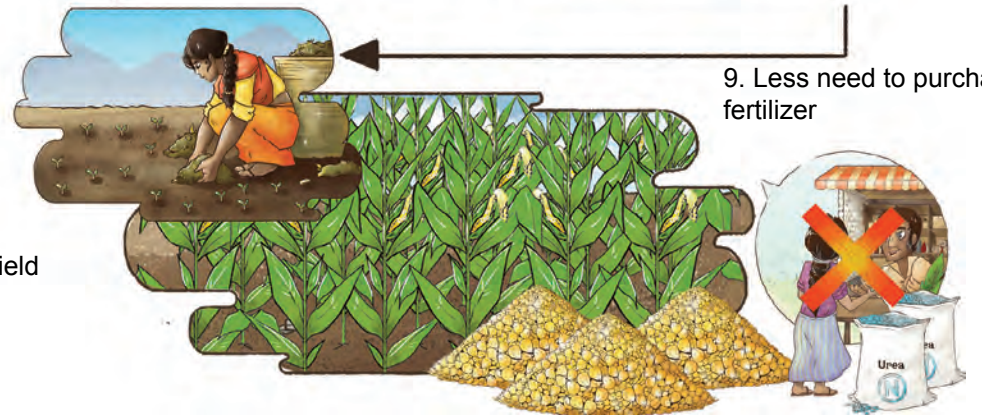


7. Store manure in pit or inside mud/stone walls and cover from rain



8. High yield

9. Less need to purchase fertilizer

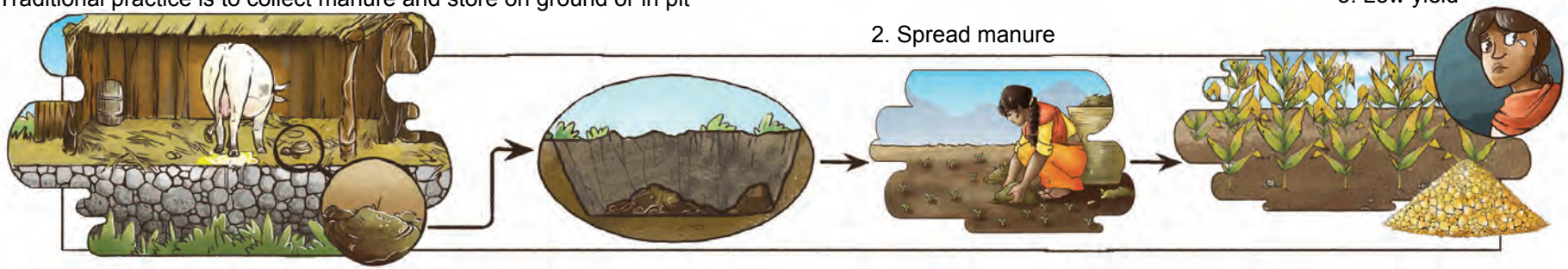


Lesson: Adding manure in layers with straw and soil in a container or pit will improve its nutrients

1. Traditional practice is to collect manure and store on ground or in pit

2. Spread manure

3. Low yield



4. Improved practice is to store manure inside walls, elevated, with repeating layers of straw, manure and soil

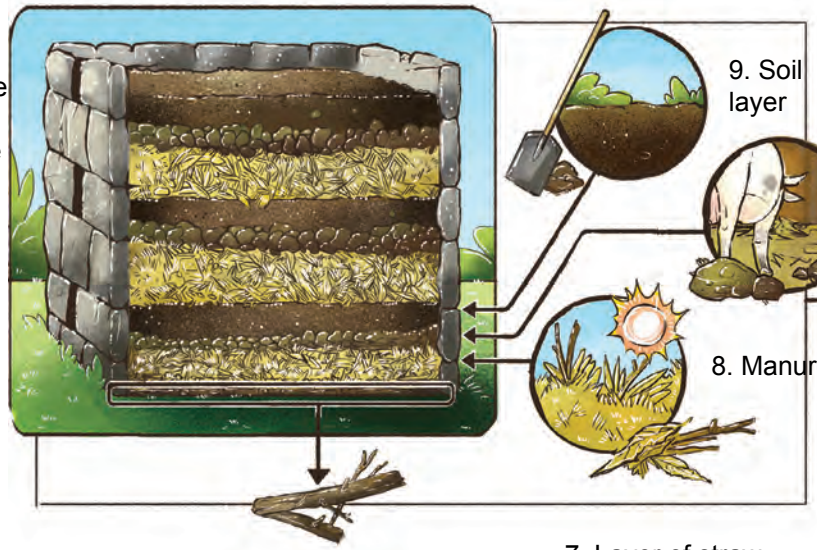
5. Create storage structure with sticks, mud or brick

9. Soil layer

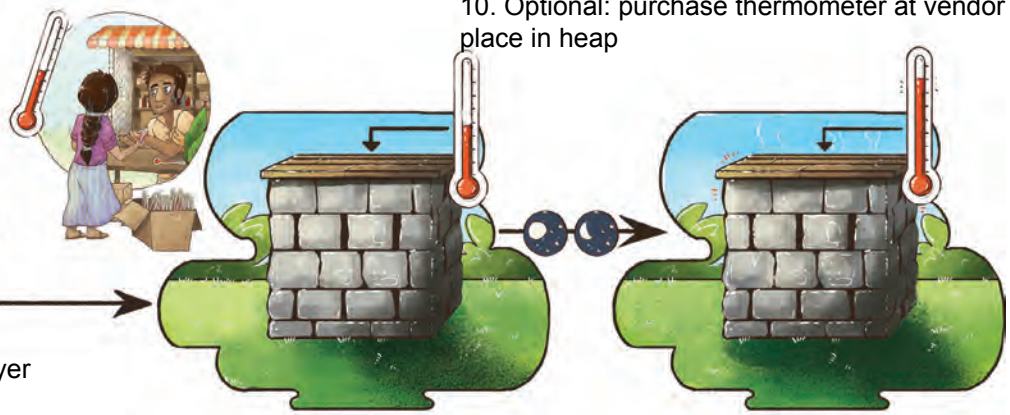
8. Manure layer

7. Layer of straw

6. Bottom should be sticks to prevent water from soaking up



10. Optional: purchase thermometer at vendor and place in heap

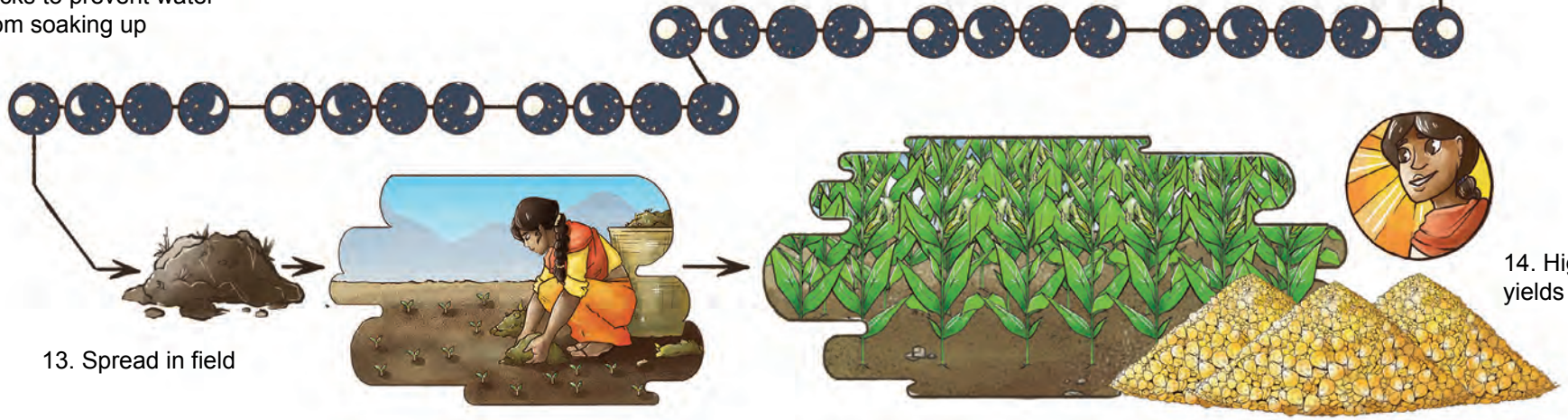


11. If heap was built properly, it should become hotter over a period of weeks.

12. Let compost incubate for several weeks

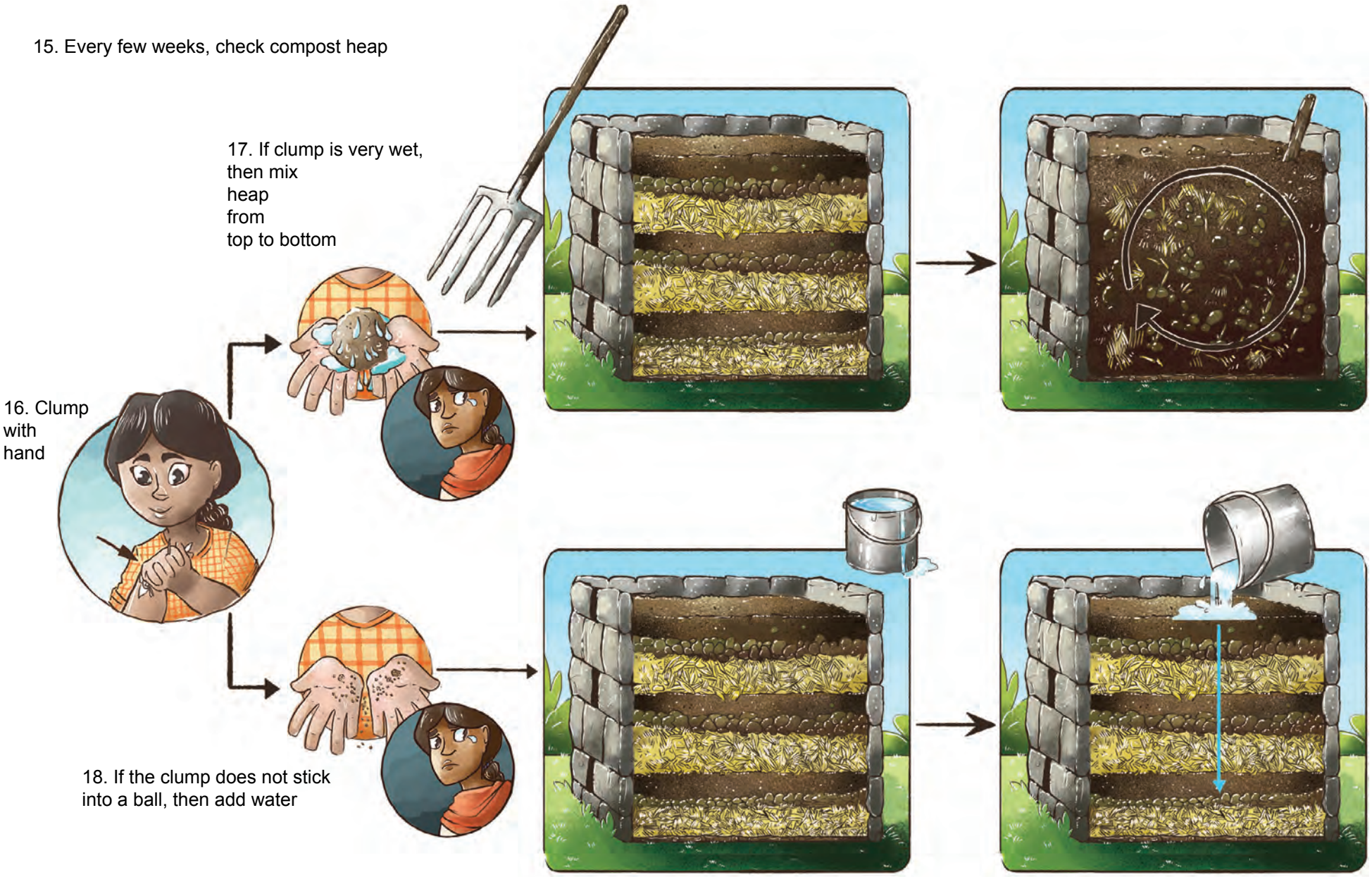
13. Spread in field

14. Higher yields



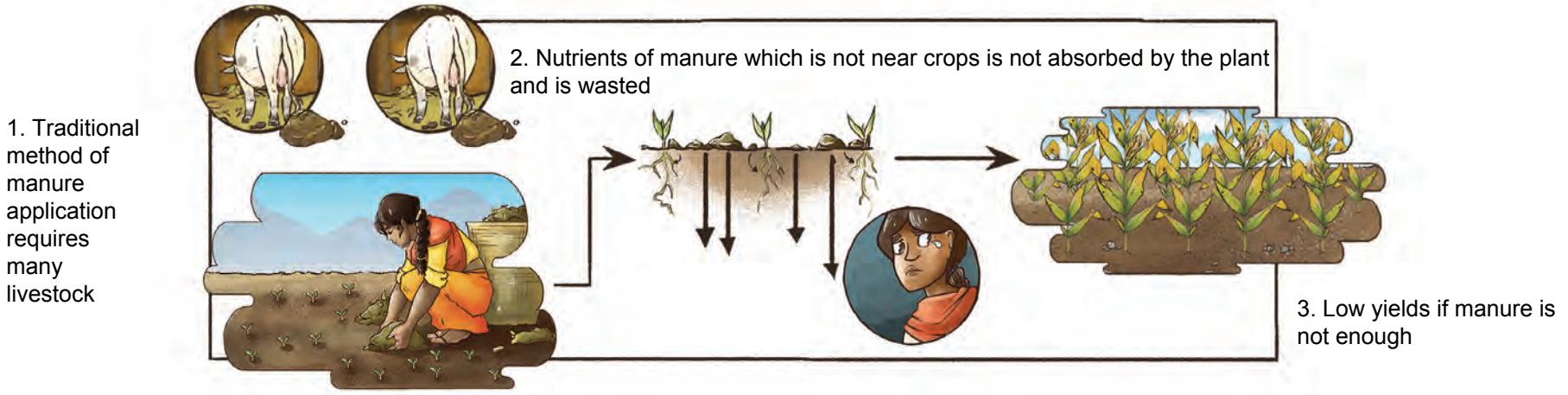
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: Adding manure in layers with straw and soil in a container or pit will improve its nutrients (continued)

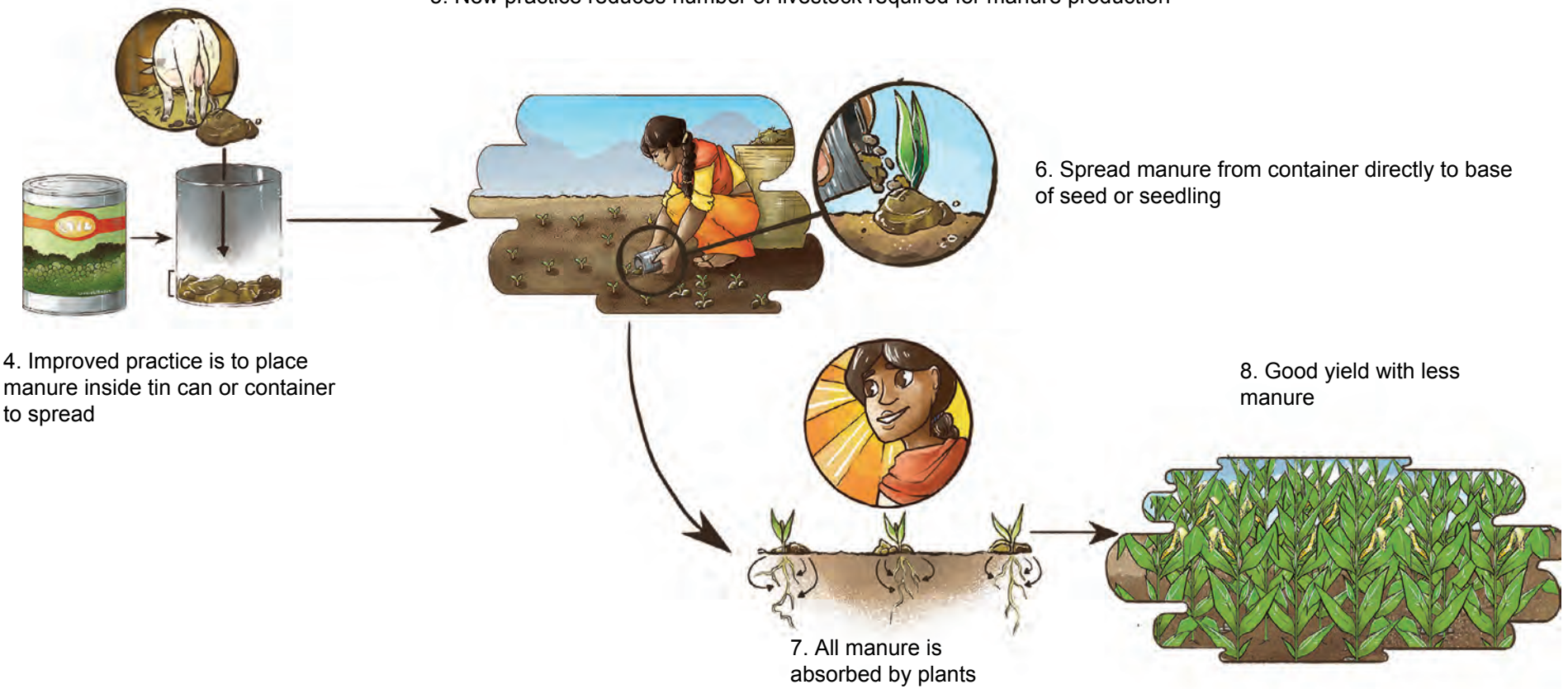


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Rather than traditional method of spreading manure, adding small amounts of manure directly to each seedling will reduce the total quantity of manure required

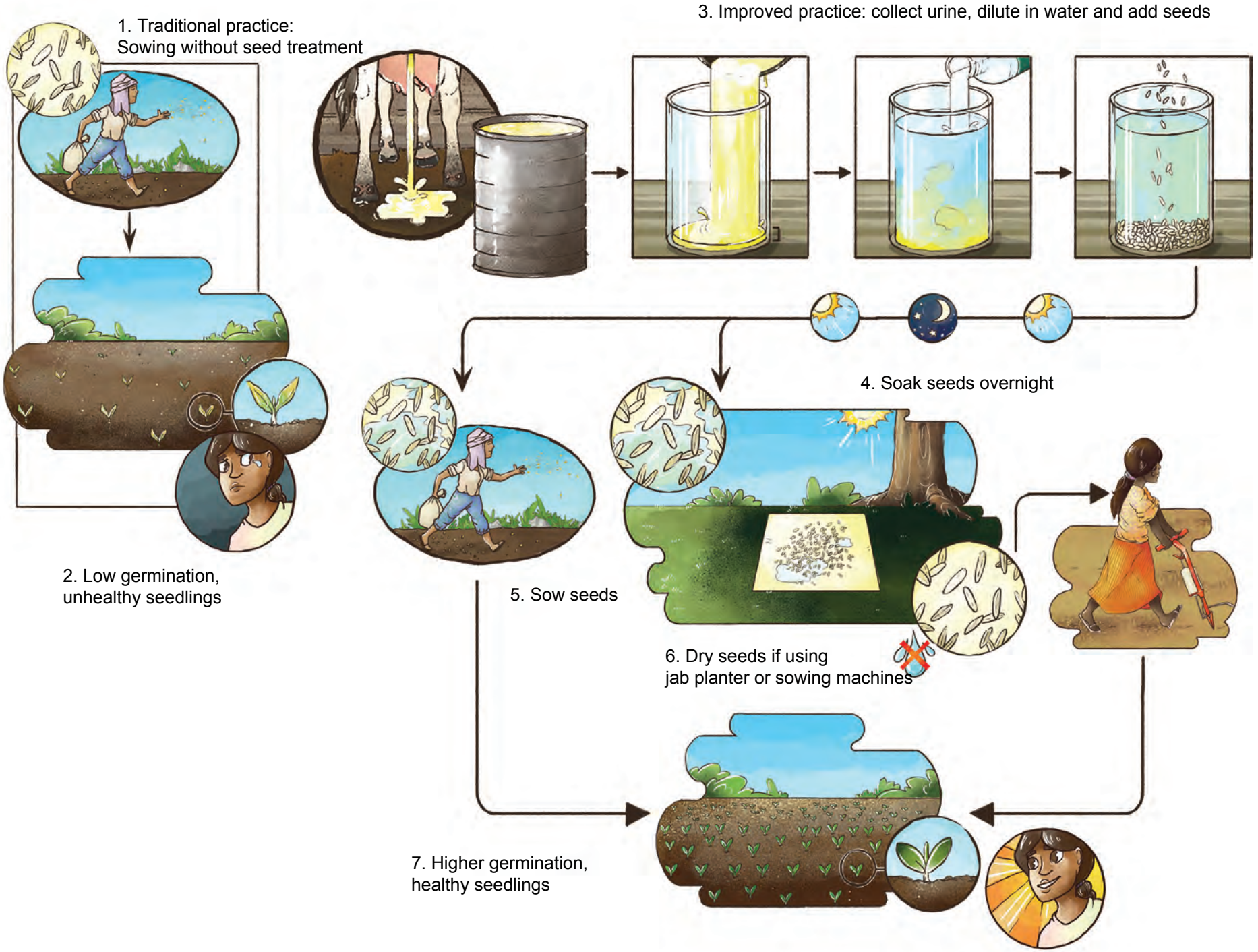


5. New practice reduces number of livestock required for manure production



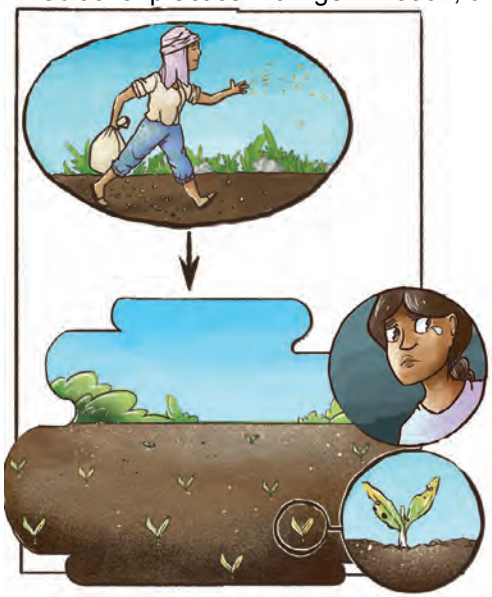
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

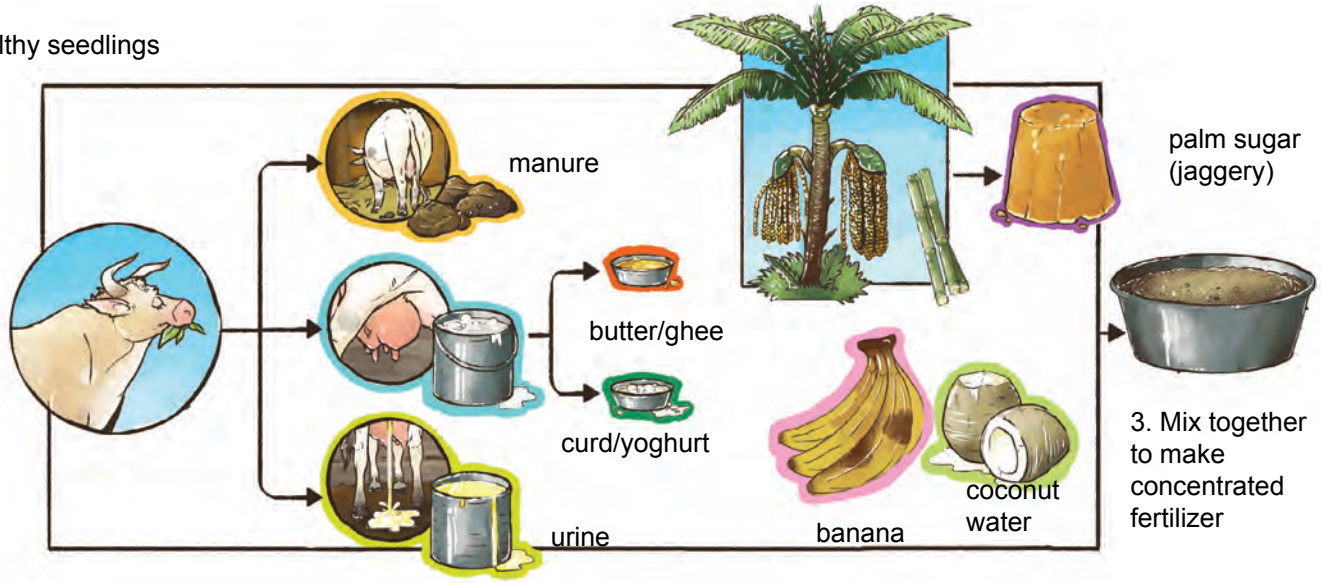
Lesson: Treatment of seeds with livestock urine will improve seed germination and health



Lesson: An indigenous biofertilizer improves germination and improves seedling health (panchakavya) (part I)

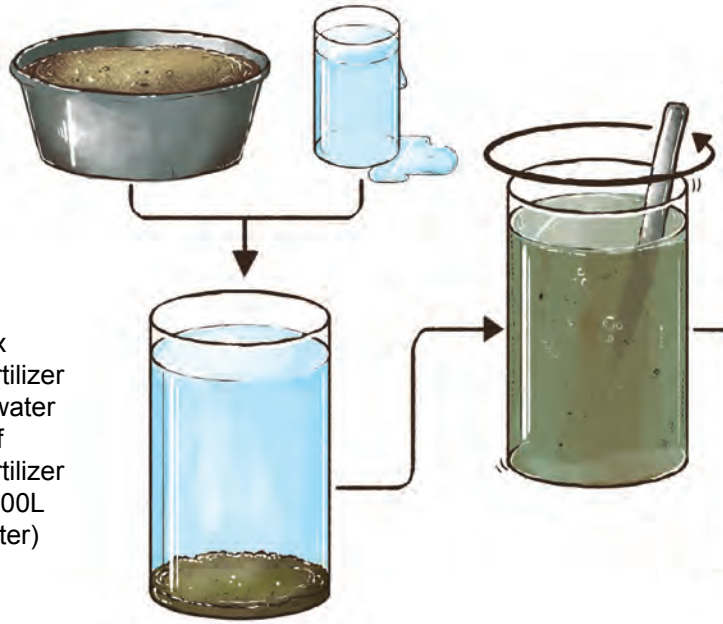
1. Traditional practice: Low germination, unhealthy seedlings



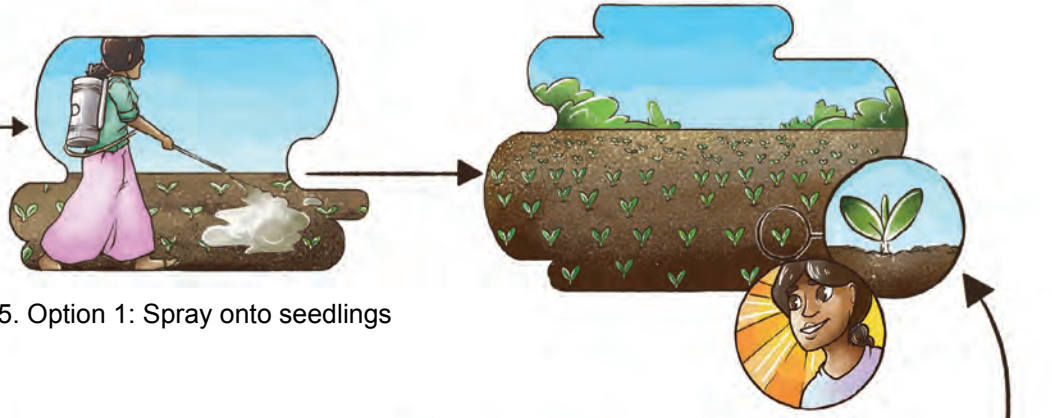


2. Ingredients required

3. Mix together to make concentrated fertilizer



4. Mix biofertilizer with water (3L of biofertilizer into 100L of water)



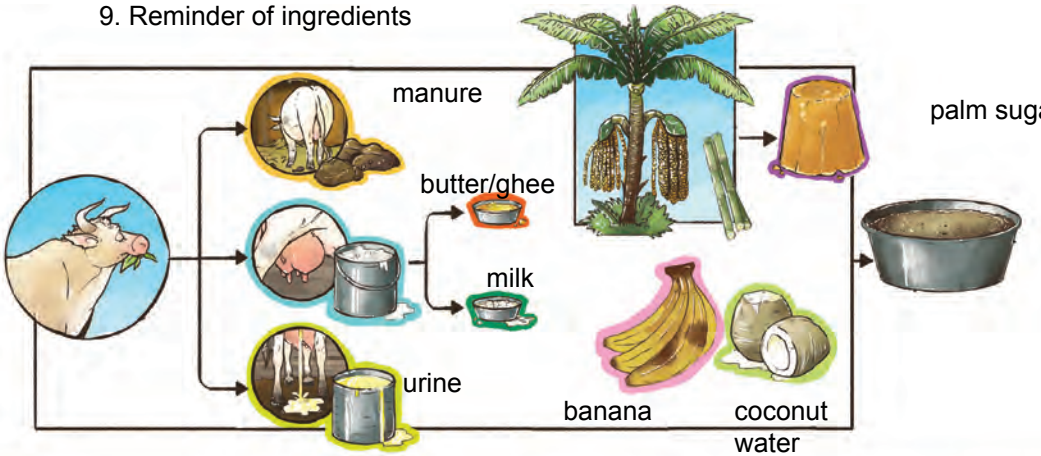
5. Option 1: Spray onto seedlings

6. Option 2: soak seeds first, then dry before spreading

Lesson: An indigenous biofertilizer improves germination and improves seedling health (panchakavya)(part 2)

8. Details of biofertilizer recipe:
Mixtures shouls be kept in shade and kept open but covered with a mosquito net

9. Reminder of ingredients



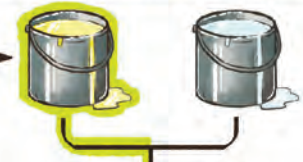
10. Mix together

11. Mix 7kg manure and 1kg butter/ghee

12. Mix morning and evening

13. Keep for 3 days

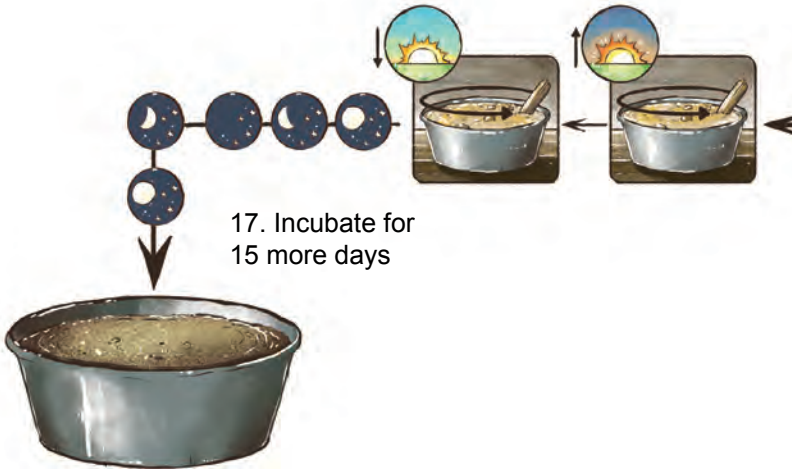
14. Add 10L cow urine and 10L water



15. Mix each morning and evening for 15 days

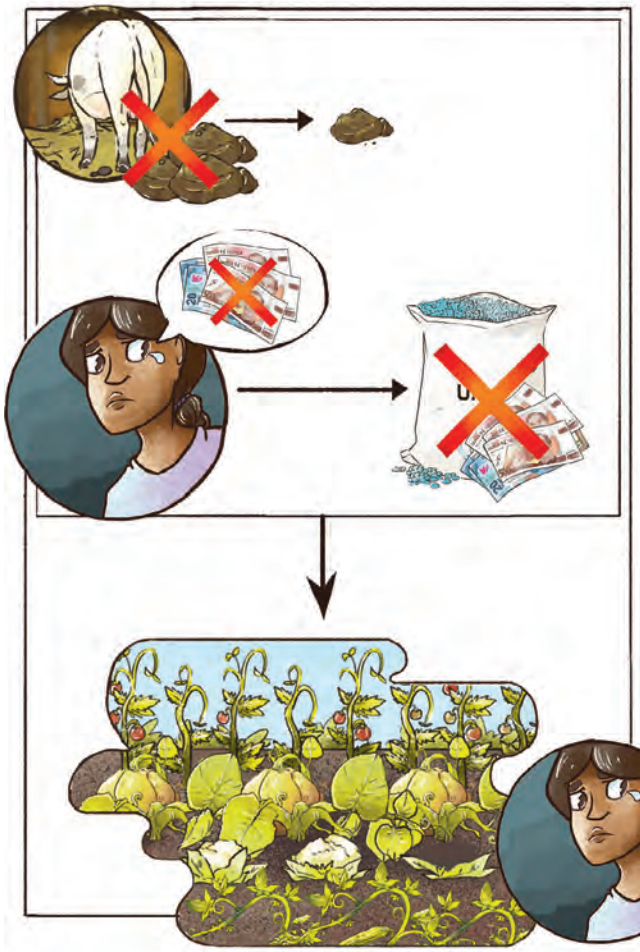
16. After 15 days, add:
cow milk - 3L
yoghur/curd - 2L
fresh coconut water - 3L
jaggery/palm sugar - 3kg
ripe banana - 12 bananas

17. Incubate for 15 more days



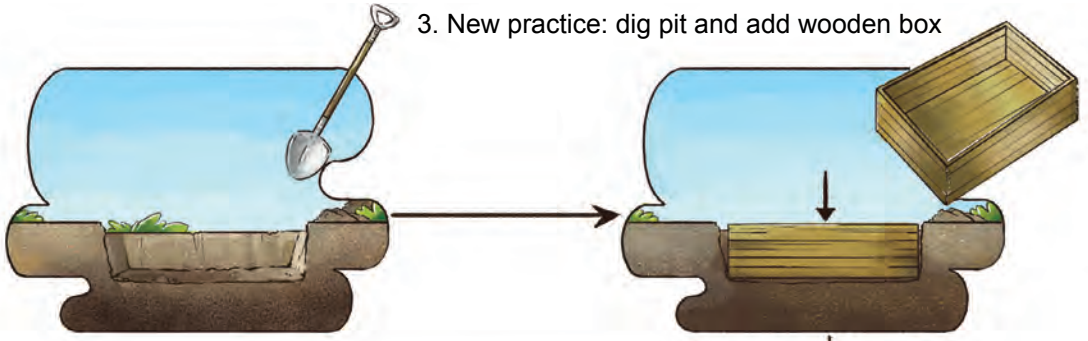
Lesson: Manure made with the help of worms can be an alternative to livestock manure or synthetic fertilizers for home gardens

1. Traditional sources of livestock manure or synthetic fertilizer may not be available or expensive



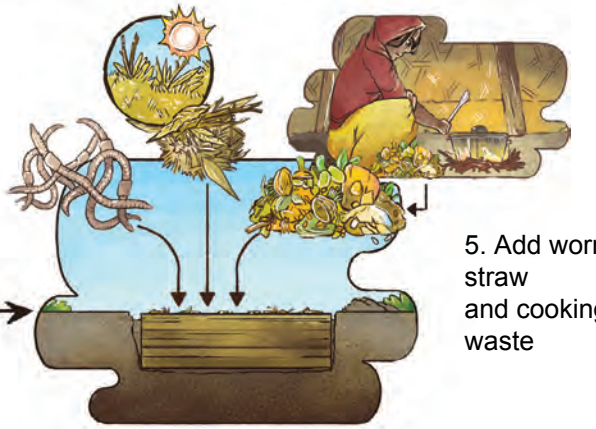
2. Low yields

3. New practice: dig pit and add wooden box



4. Collect earthworms after rain

5. Add worms, straw and cooking waste



6. Time passes

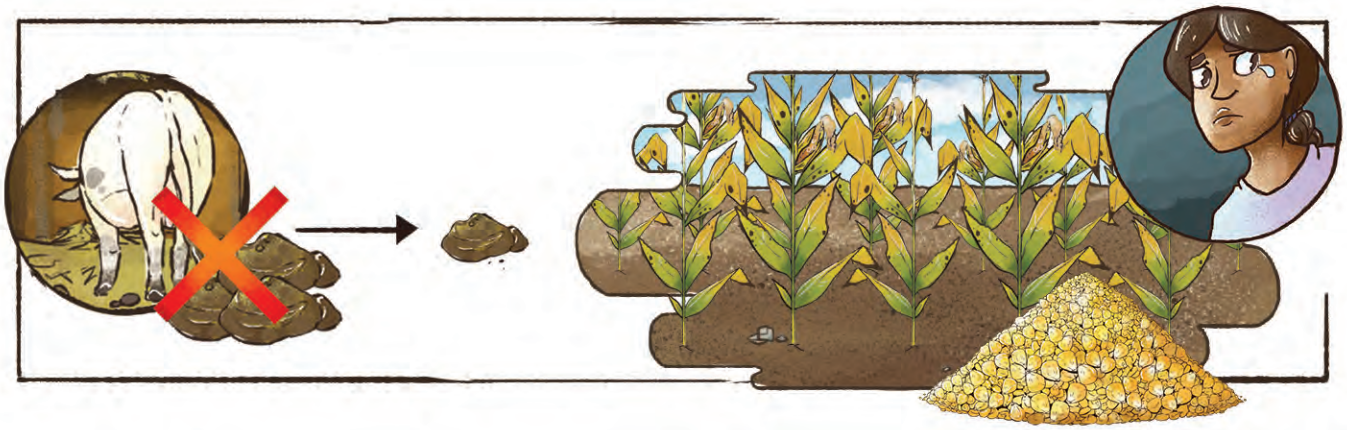
7. Worms will eat straw and waste and convert to manure

8. Add worm manure, high yields

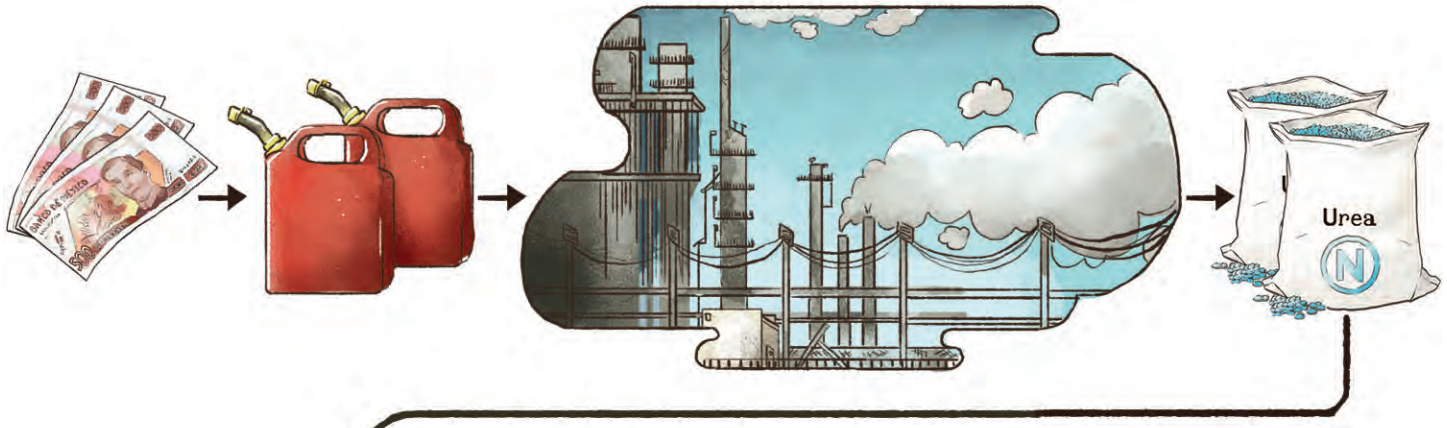
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

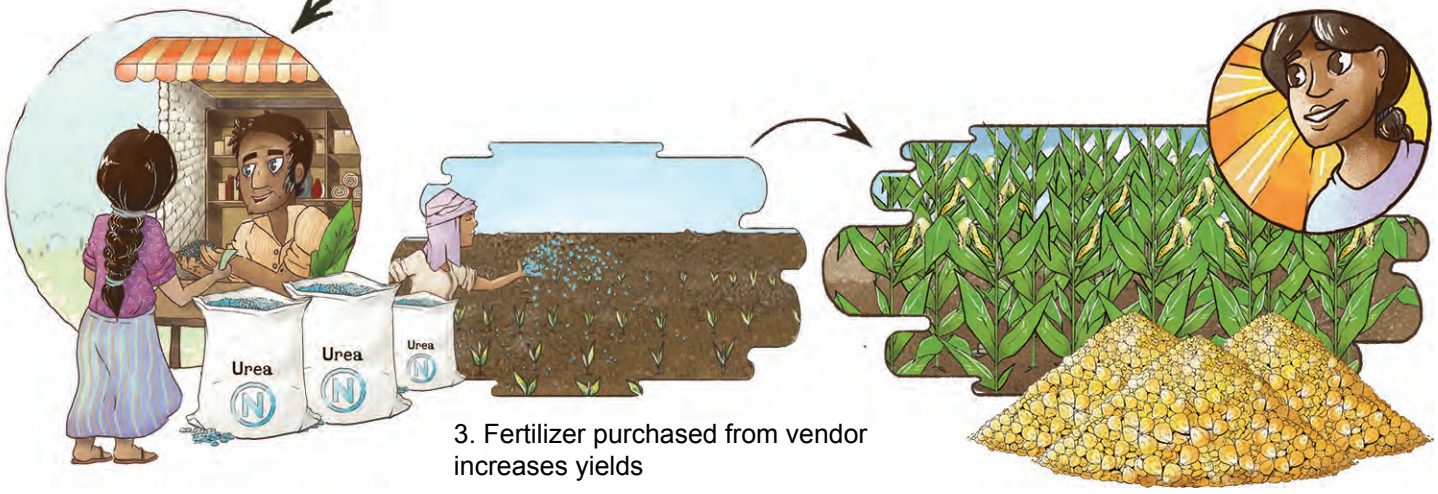
Lesson: Synthetic nitrogen fertilizer raises crop yields

1. If not fertilizer or manure, crop yields are low



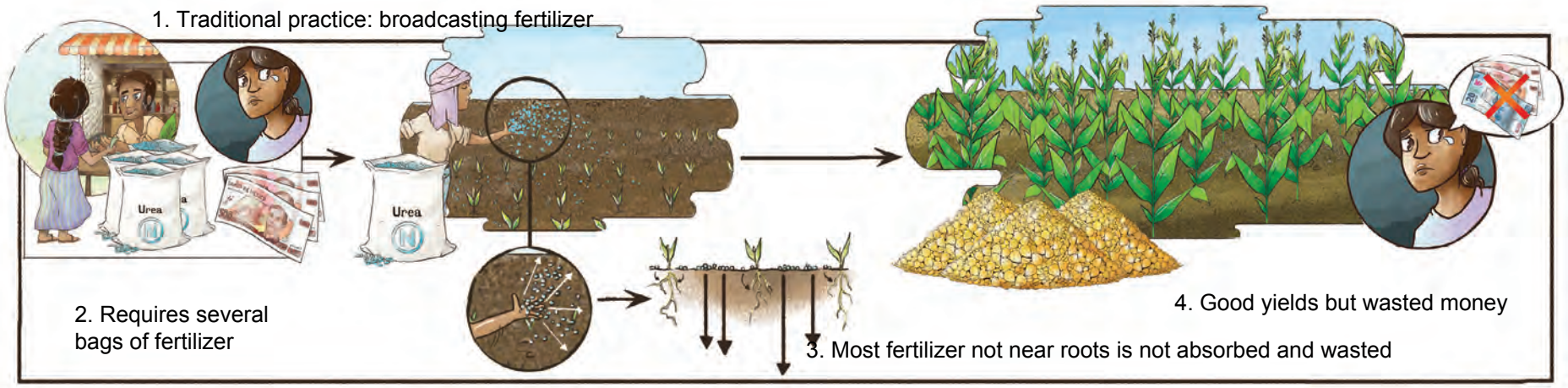
2. Synthetic nitrogen fertilizer is created in factories using natural gas or petrol, hence when petrol prices increase, fertilizer price will increase

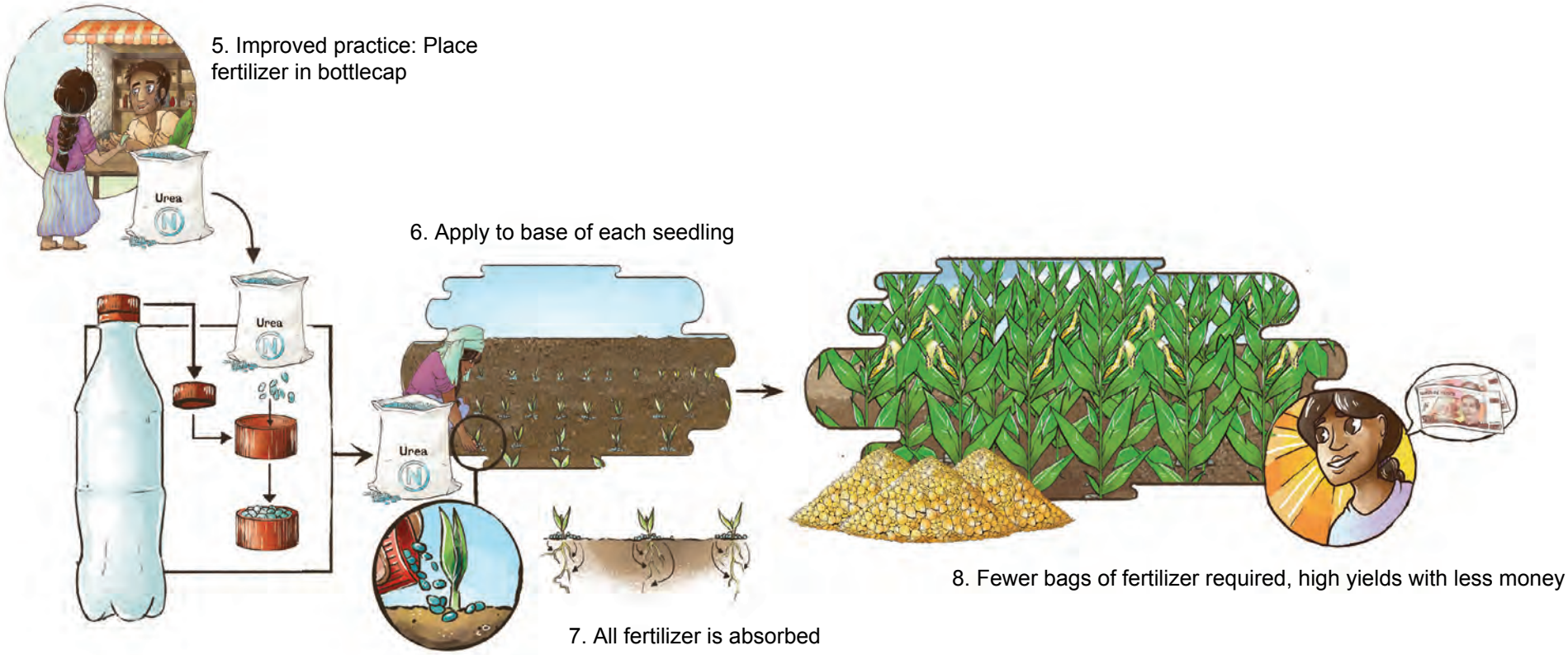




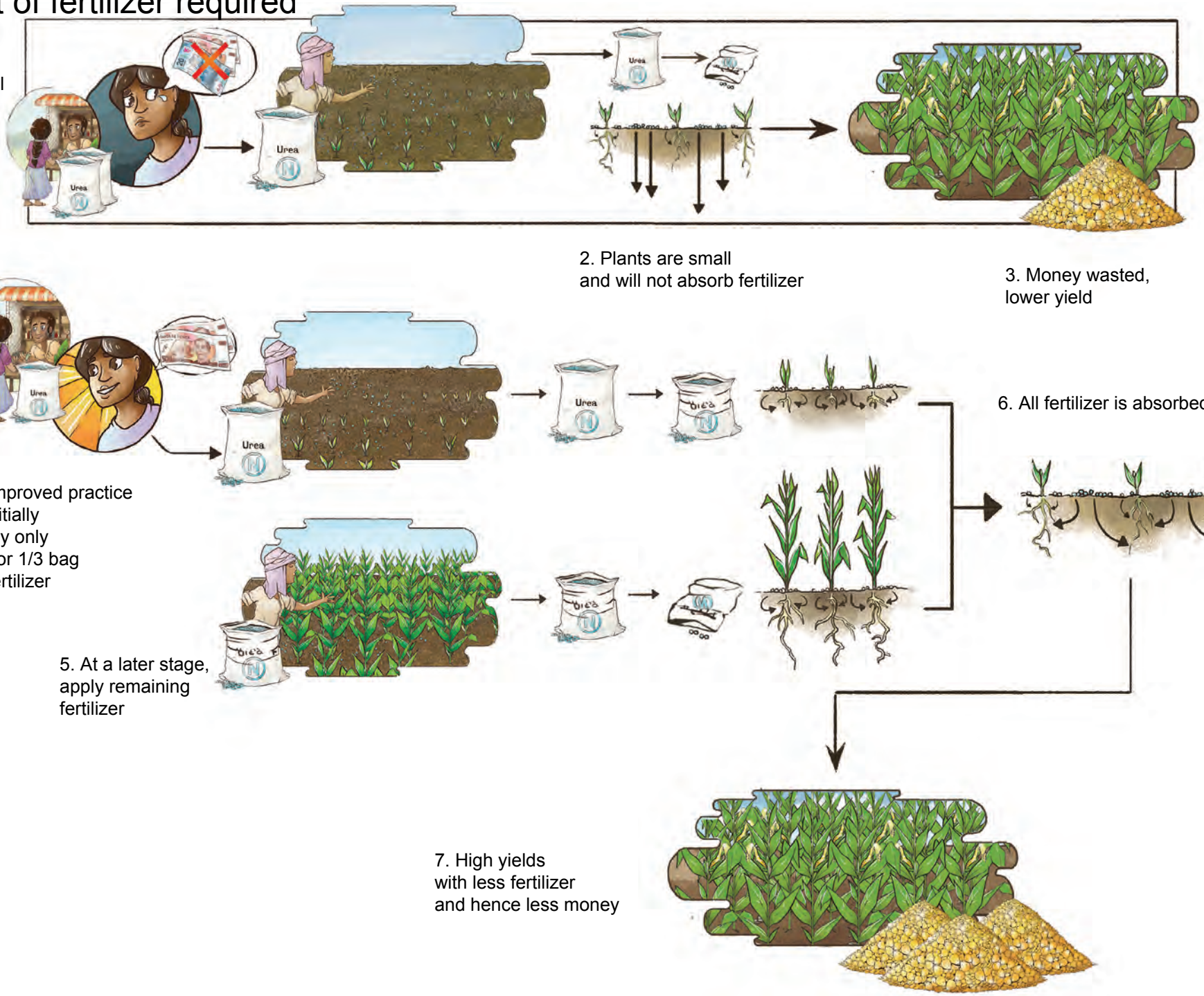
3. Fertilizer purchased from vendor increases yields

Lesson: Rather than random broadcasting of fertilizer, adding small amounts using a bottle cap directly to each seed or seedling reduces the total amount of fertilizer required

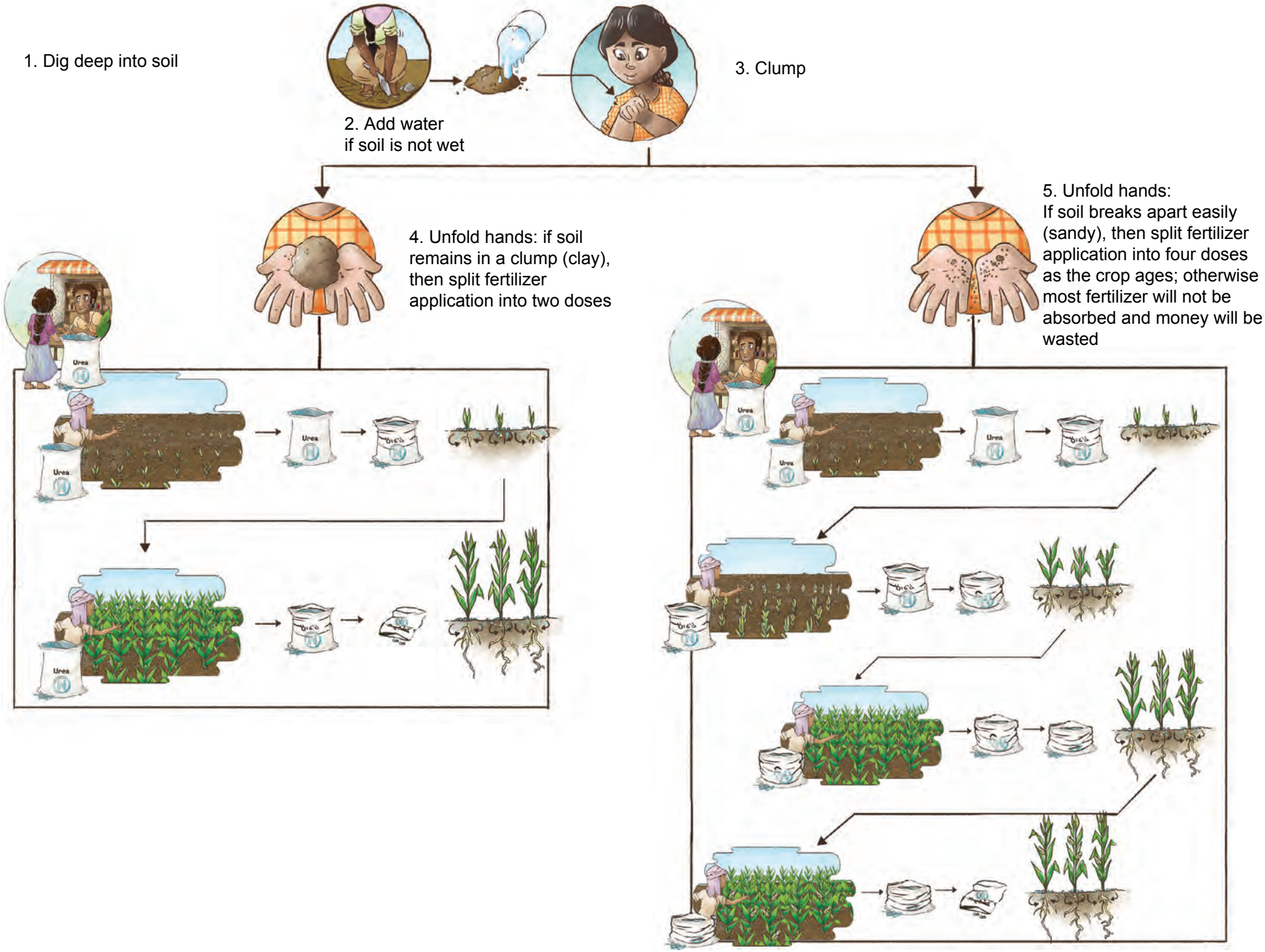




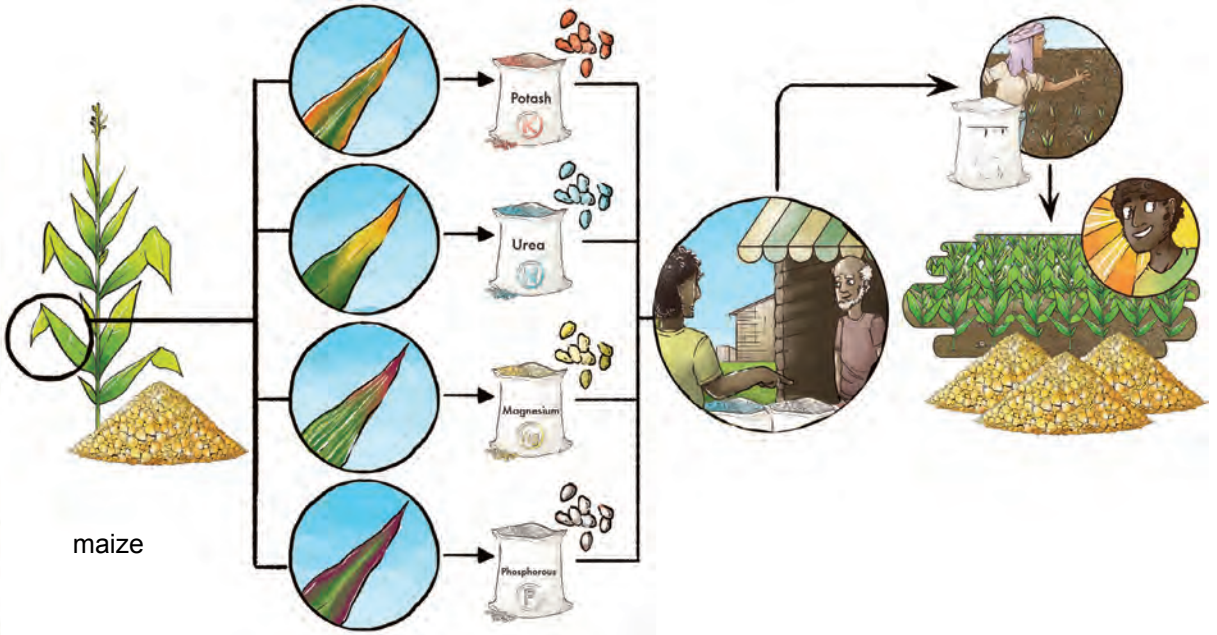
Lesson: Rather than applying all fertilizer in a single dose, splitting the doses will reduce the amount of fertilizer required



Lesson: Artificial fertilizers should be applied differently on different soil-texture types

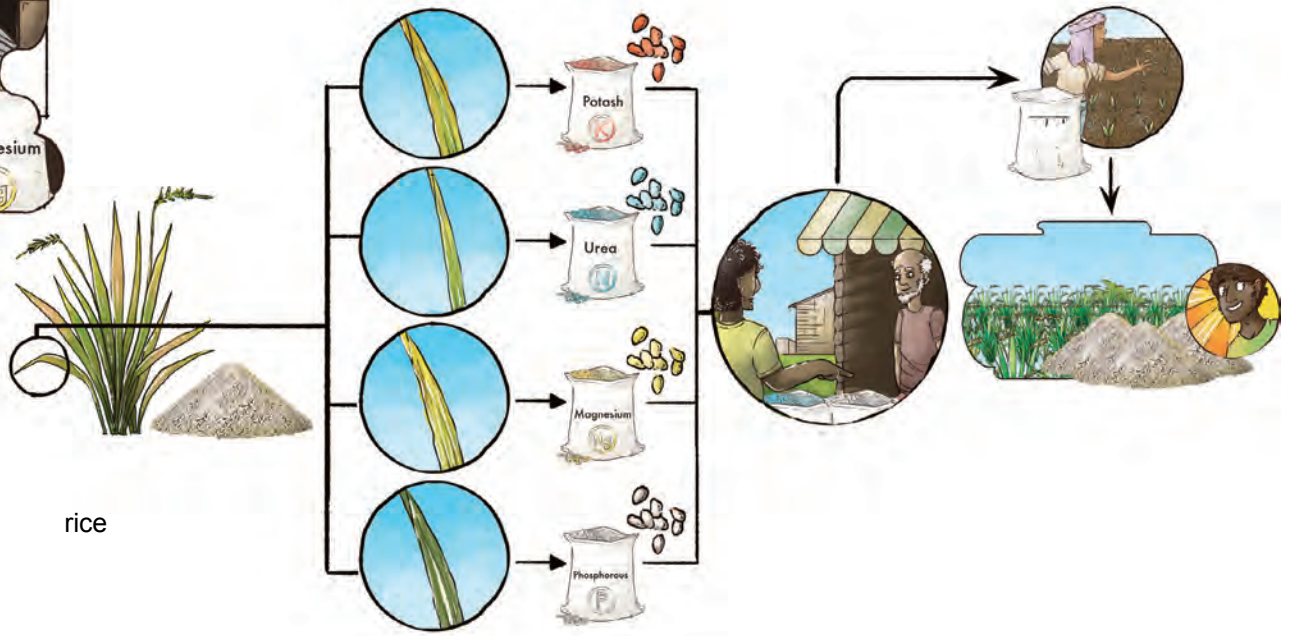


1. Traditional practice: crops are sick but the reason is unknown. To fix, a farmer purchases different fertilizers or pesticides but none may solve the problem.



maize

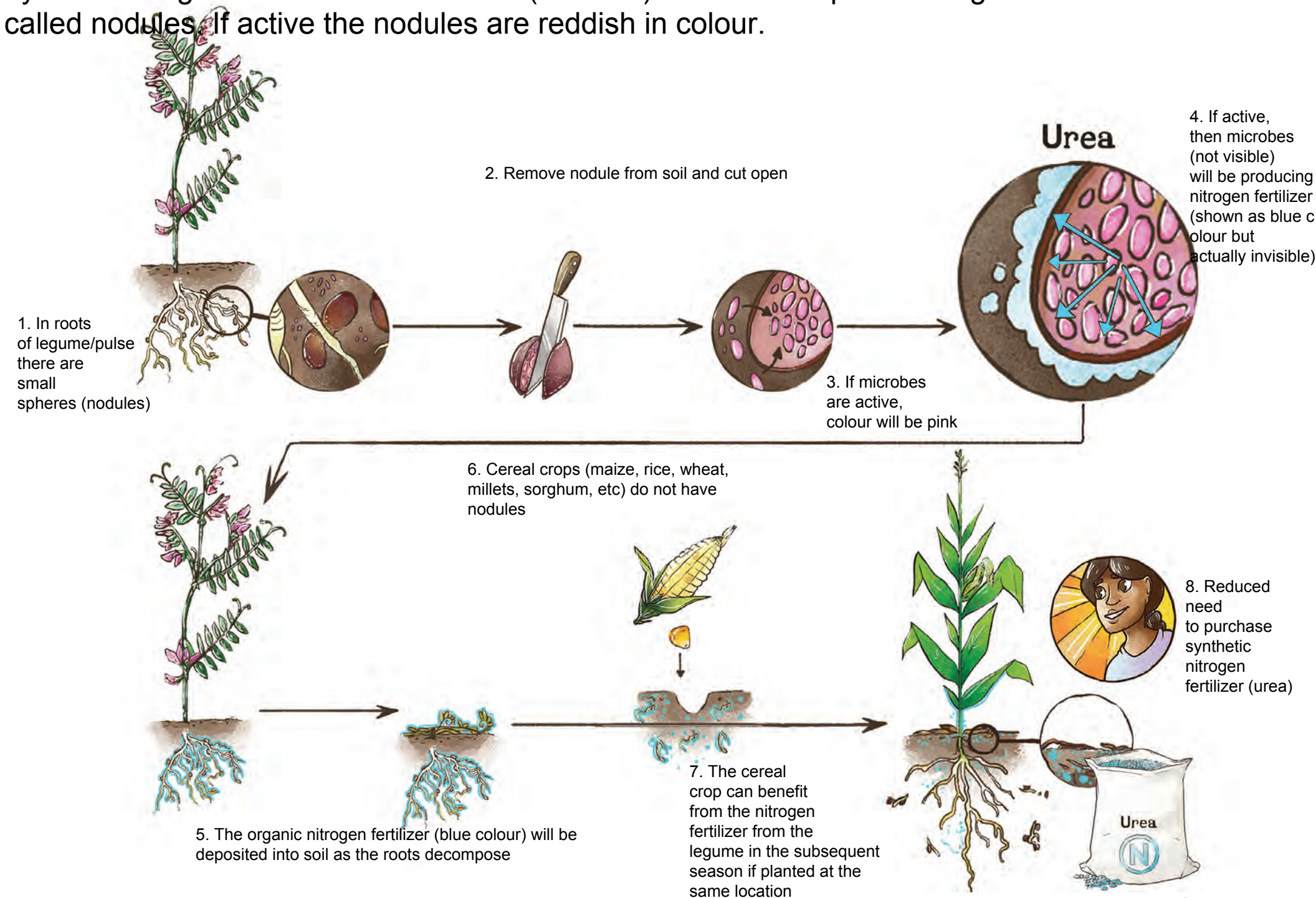
2. Improved practice is look for a change in the colour and pattern on the leaves, then purchase the appropriate fertilizer if needed to achieve good yields



rice

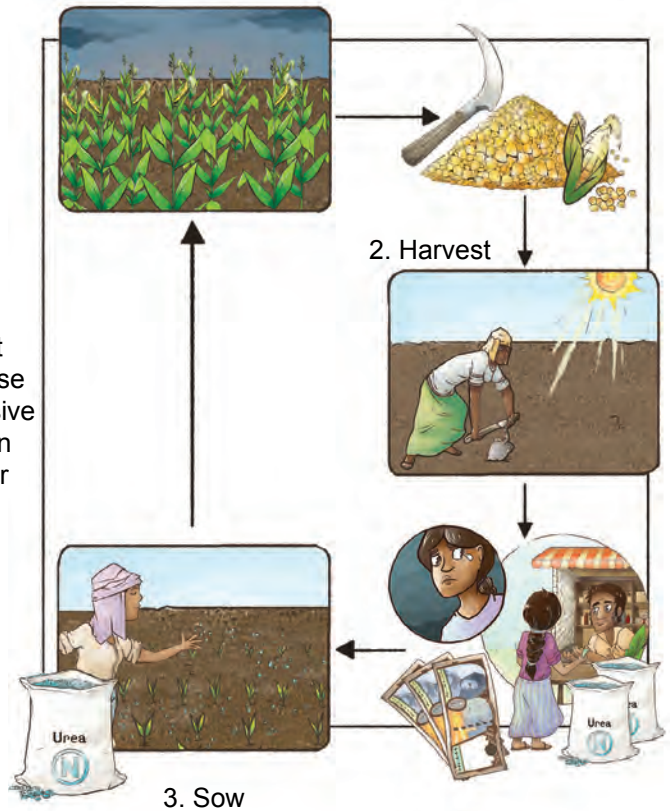
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Background educational lesson: A legume (bean) or pulse can produce organic nitrogen fertilizer by associating with beneficial microbes (rhizobia) that inhabit spherical organs in the roots called nodules. If active the nodules are reddish in colour.



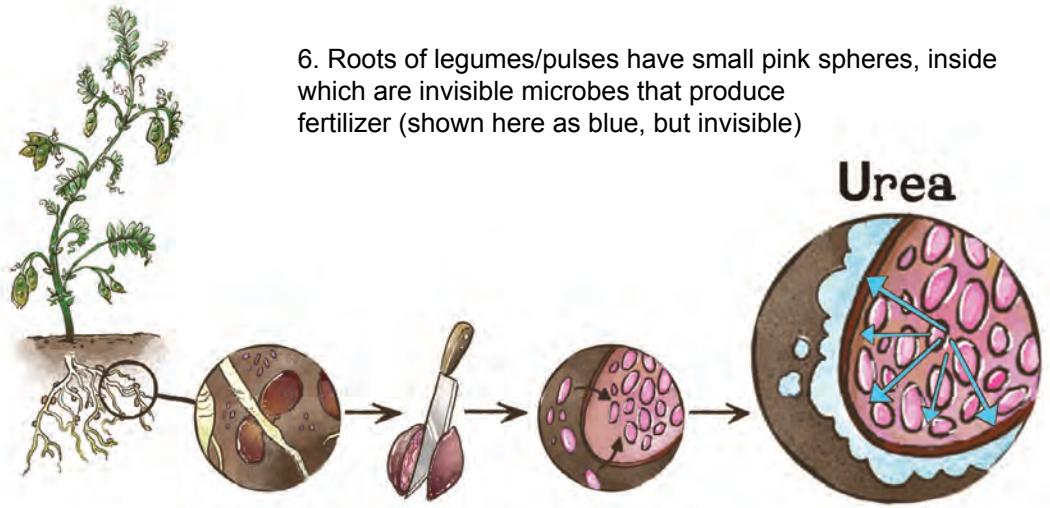
Background educational lesson: The roots of legume and pulses have little spheres in which helpful microbes make natural nitrogen fertilizer to reduce need to purchase artificial fertilizer.

1. Bad practice: plant sole crop of maize wheat, rice, millet in all seasons (no legumes, no pulses)

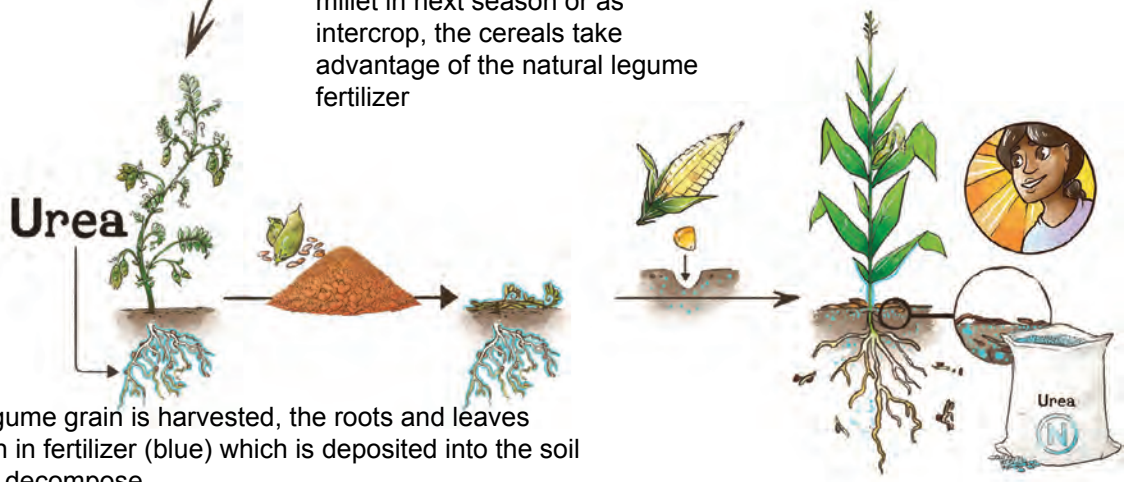


5. Improved practice: Plant legumes or pulses (e.g. lentil) as intercrop or in next season

6. Roots of legumes/pulses have small pink spheres, inside which are invisible microbes that produce fertilizer (shown here as blue, but invisible)



8. If sow maize, rice or wheat or millet in next season or as intercrop, the cereals take advantage of the natural legume fertilizer



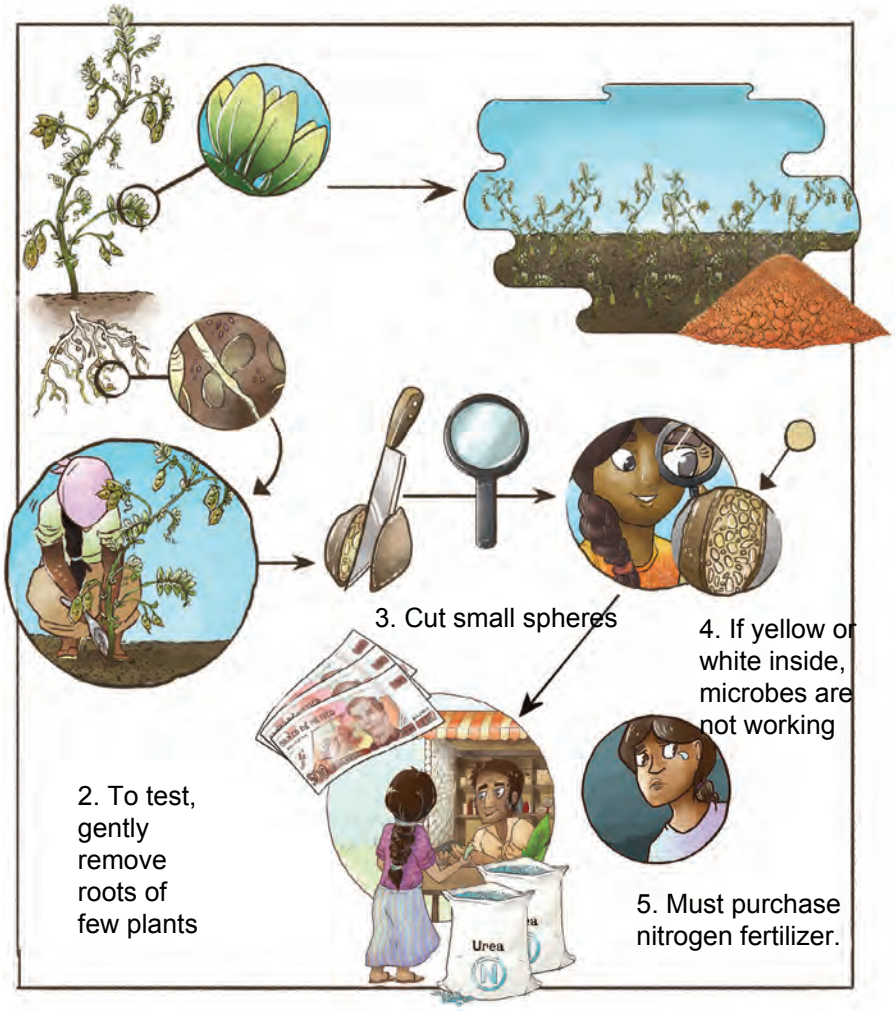
7. After legume grain is harvested, the roots and leaves remain rich in fertilizer (blue) which is deposited into the soil when they decompose

9. Less need to purchase nitrogen fertilizer

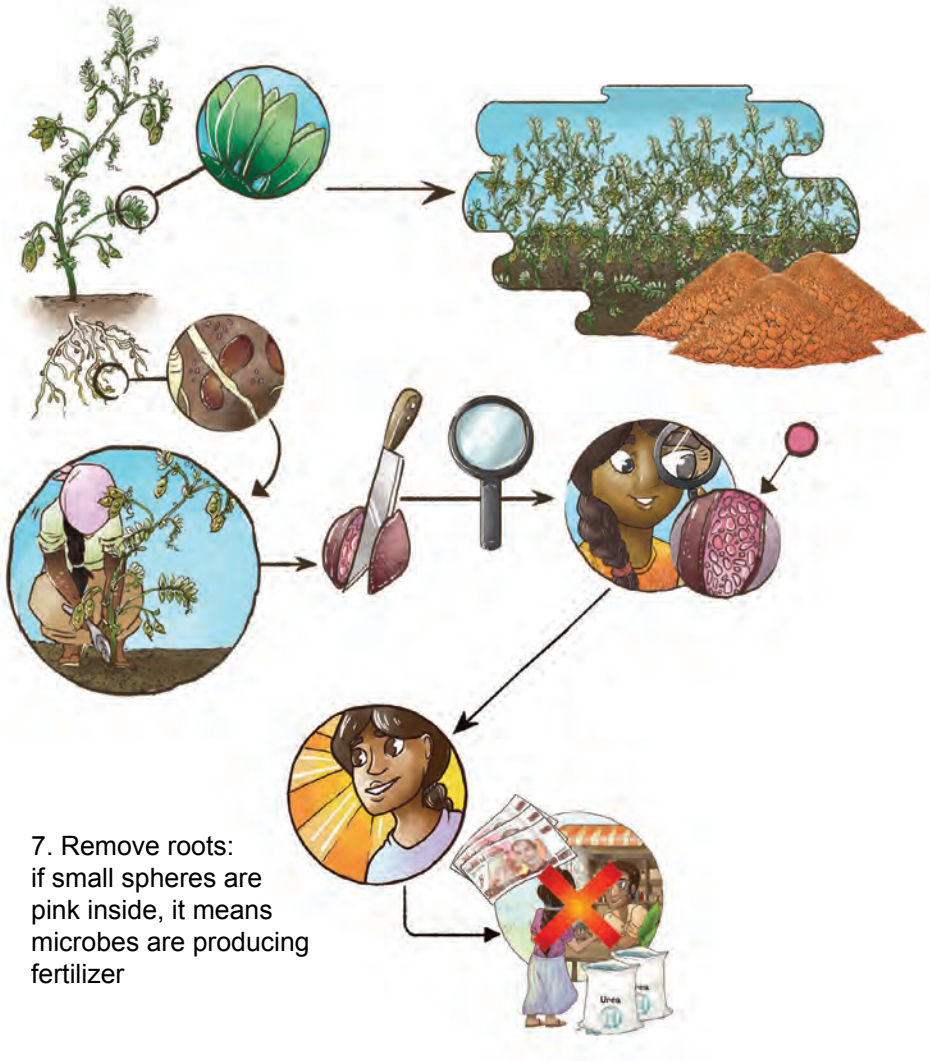
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: If small spheres on legume roots are only yellow inside, they do not contain healthy microbes to make natural nitrogen fertilizer, but a pink colour inside means they are producing fertilizer

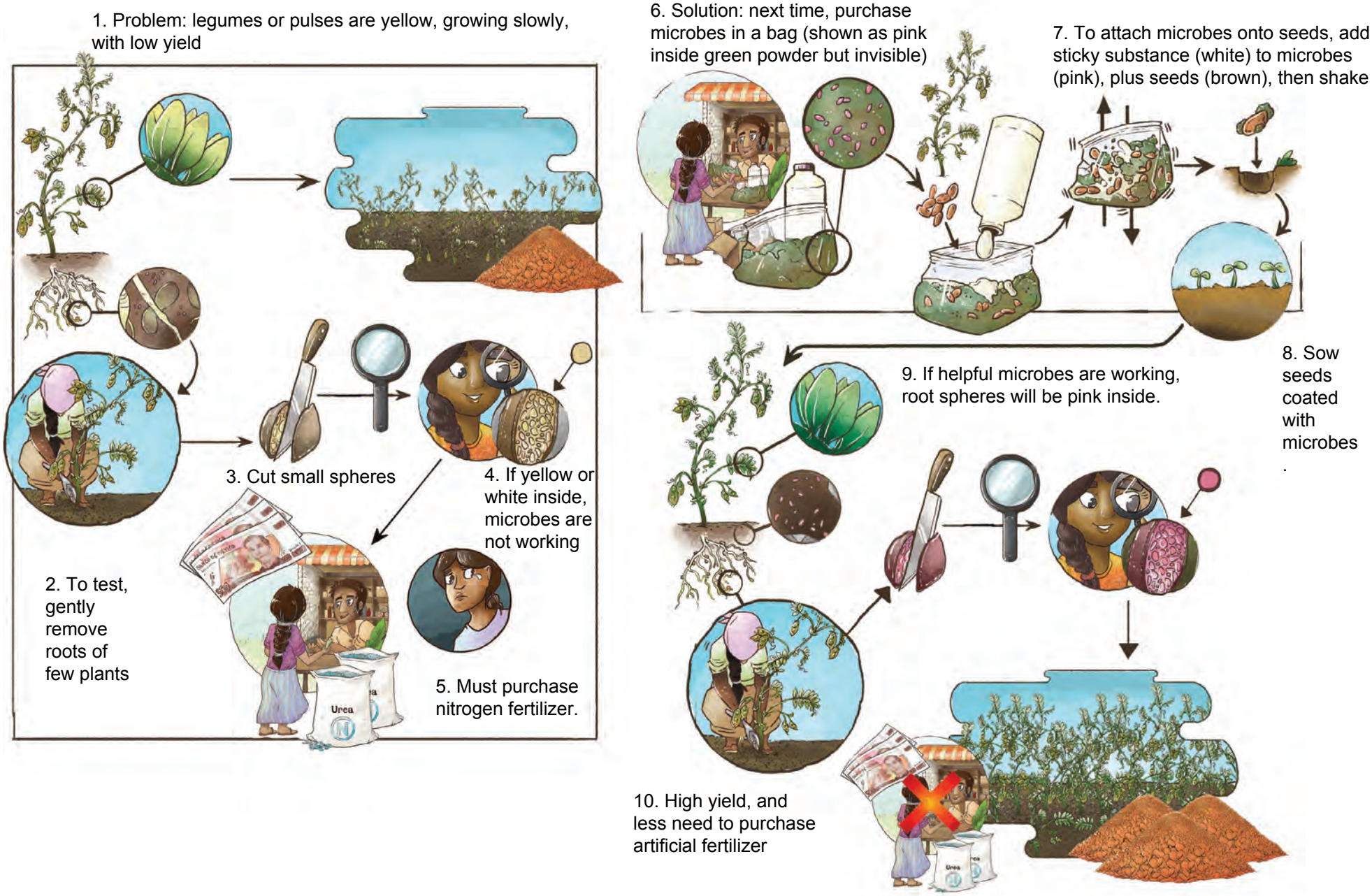
1. Problem: legume leaves such as lentil are yellow causing low yields: might be disease or lack of fertilizer



6. Good situation: legume plants appear green.

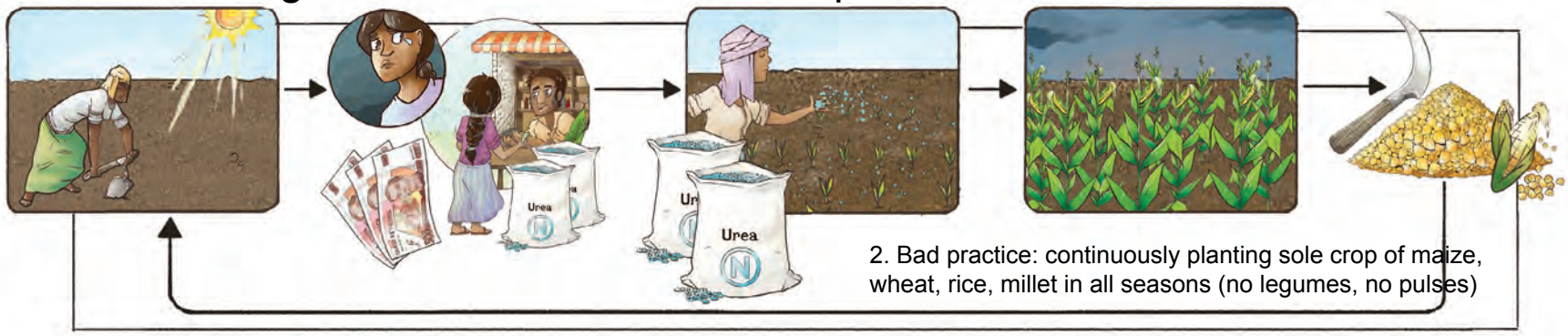


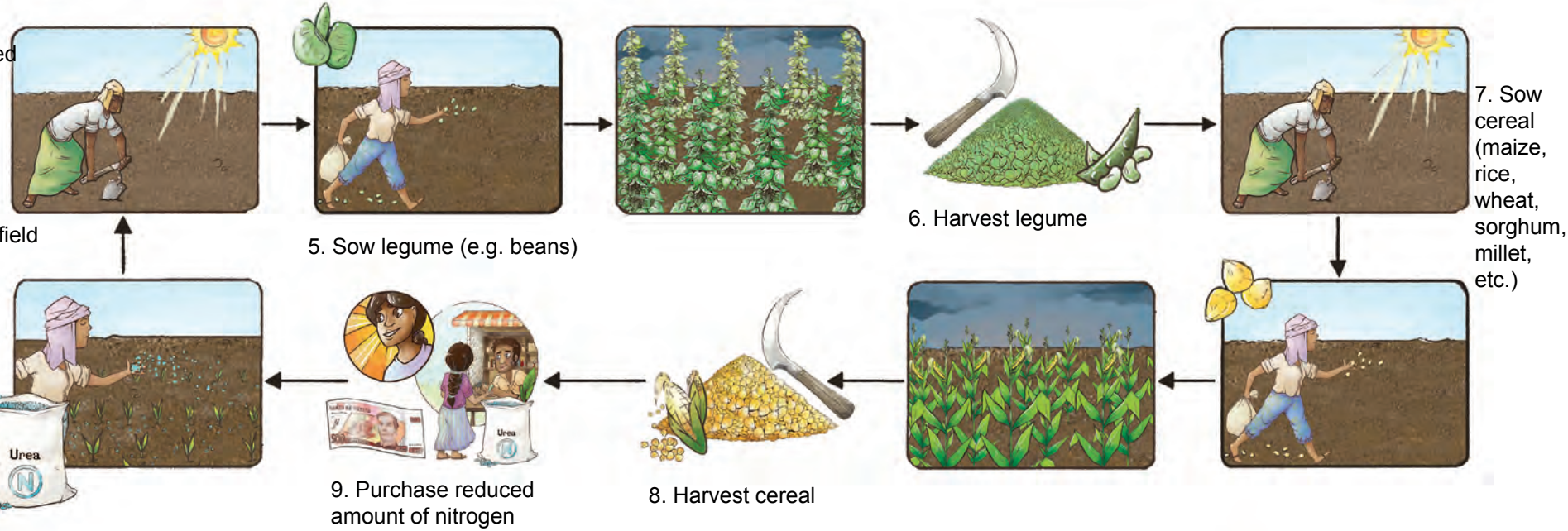
Lesson: If helpful microbe inside small spheres of legume roots are not making natural nitrogen fertilizer, the problem may be fixed in the future by purchasing healthy microbes called rhizobia and coating onto seeds. Seeds may also be purchased already coated with the microbes.

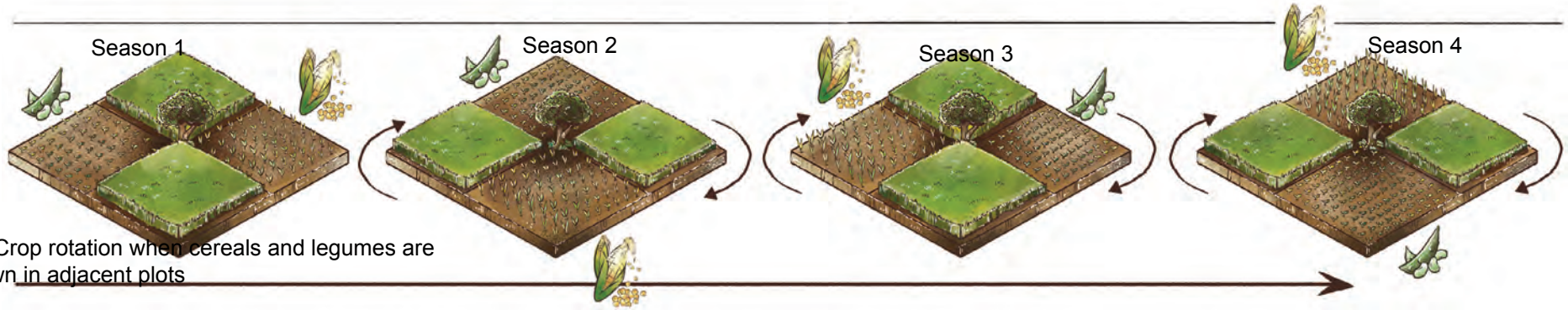


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

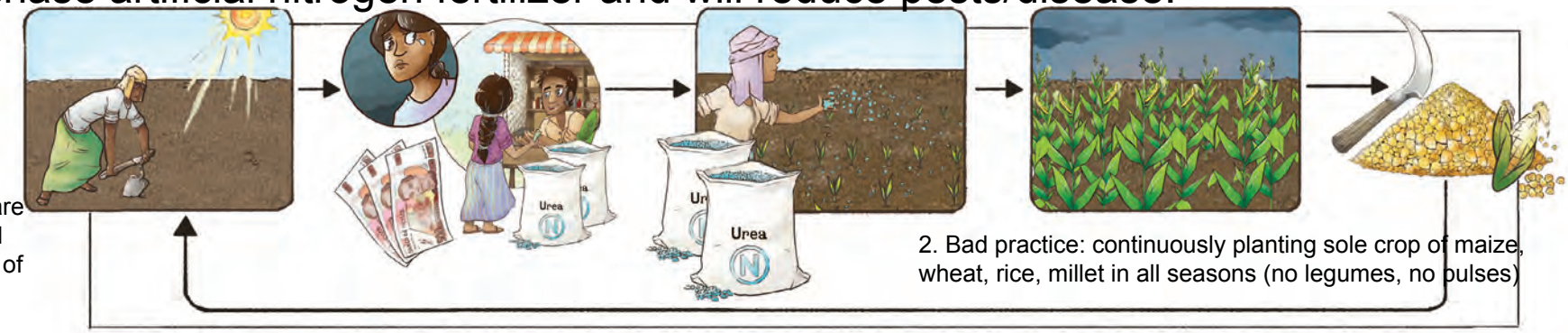
Lesson: Rotating a cereal crop (e.g. maize) with a legume crop (e.g. beans) will reduce need to purchase artificial nitrogen fertilizer and will reduce pests/disease.





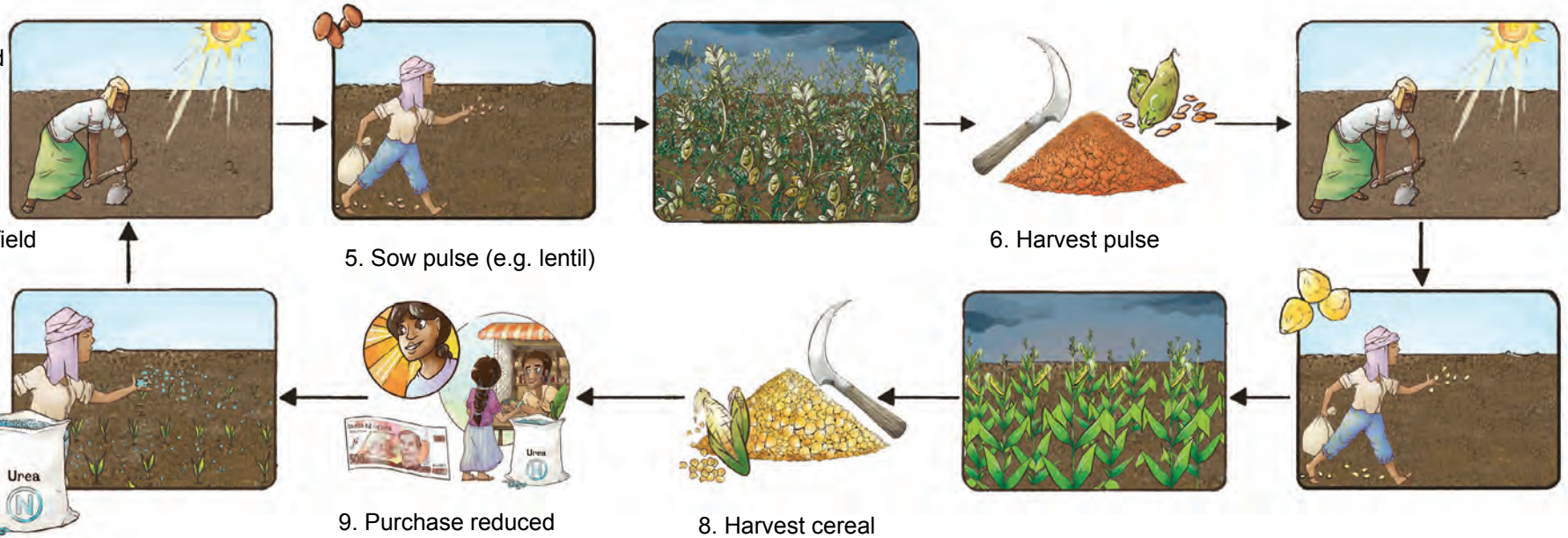


Lesson: Rotating a cereal crop (e.g. maize) with a legume pulse crop (e.g. lentils) will reduce need to purchase artificial nitrogen fertilizer and will reduce pests/disease.



1. Prepare field and add lots of fertilizer

2. Bad practice: continuously planting sole crop of maize, wheat, rice, millet in all seasons (no legumes, no pulses)



3. Improved practice

4. Prepare field

5. Sow pulse (e.g. lentil)

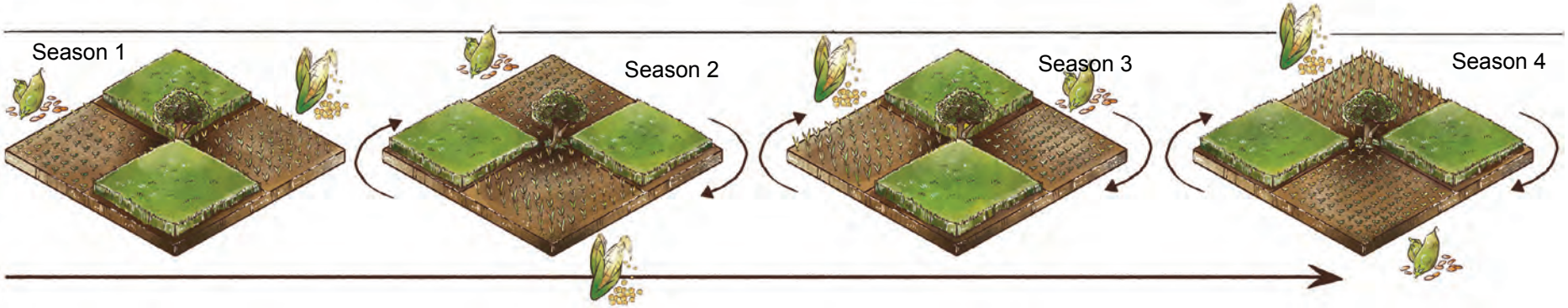
6. Harvest pulse

7. Sow cereal (maize, rice, wheat, sorghum, millet, etc.)

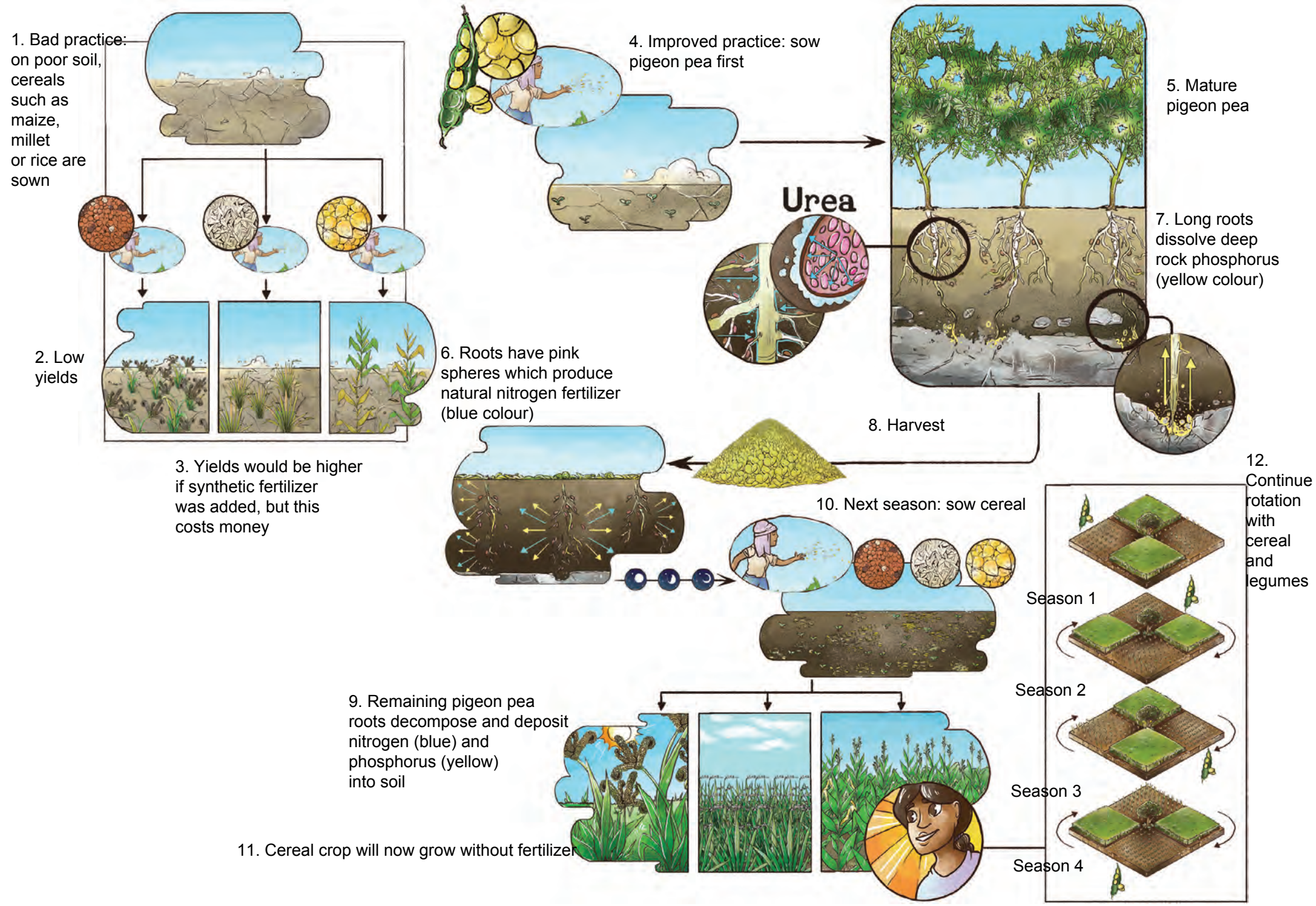
8. Harvest cereal

9. Purchase reduced amount of nitrogen fertilizer

10. Crop rotation when cereals and legumes are grown in adjacent plots

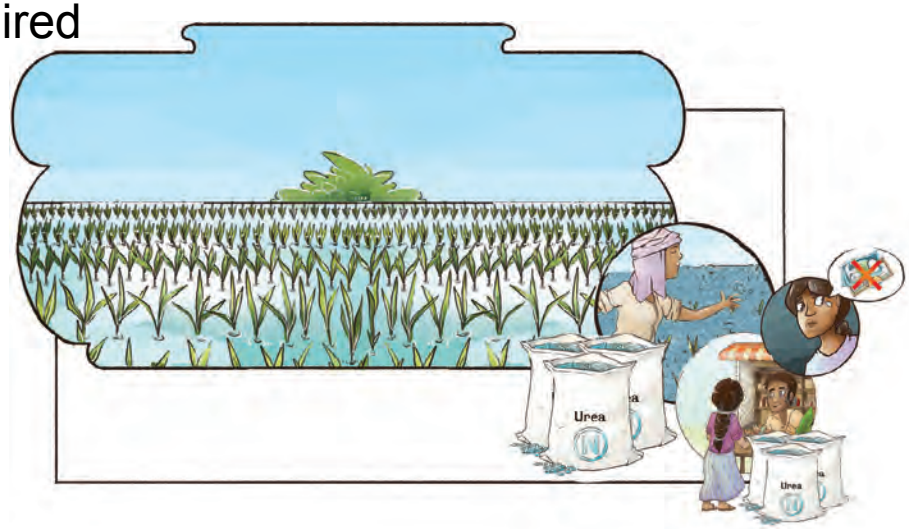


Lesson: When soil is poor, it is better to plant pigeon pea first instead of a cereal crop



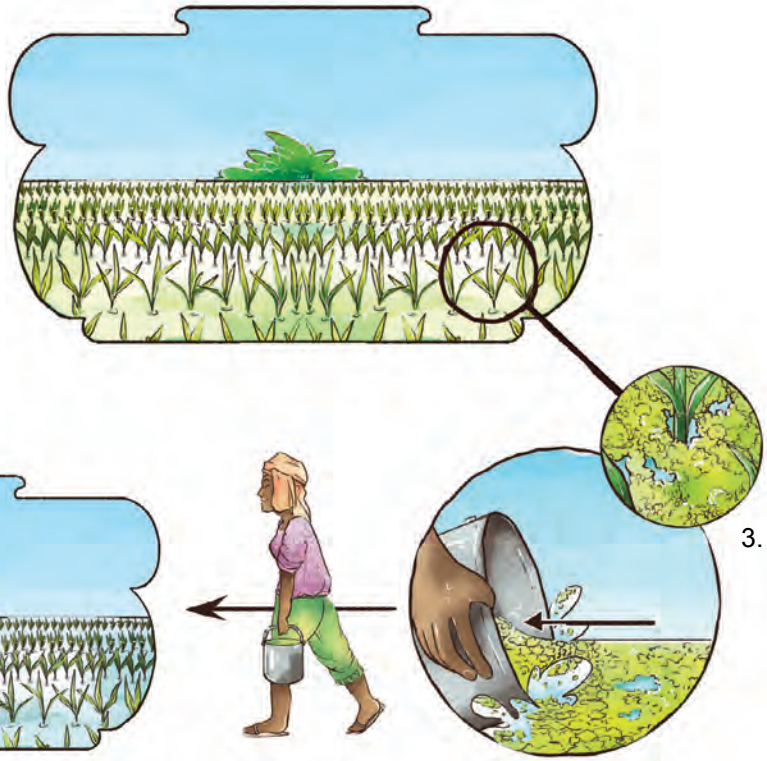
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: In a rice paddy, water algae called Azolla can reduce the amount of nitrogen fertilizer required

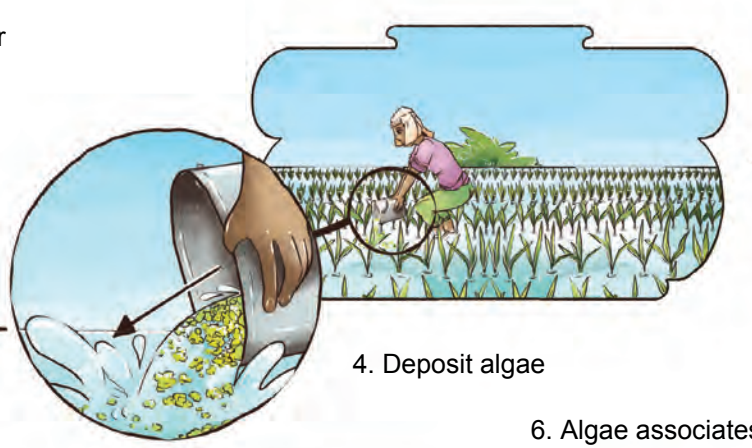


1. Traditional practice: no water algae, and hence many bags of artificial nitrogen fertilizer must be applied

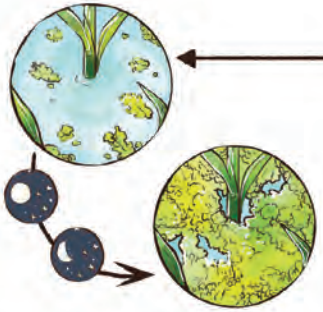
2. Improved practice: go with buckets to rice paddy with green algae



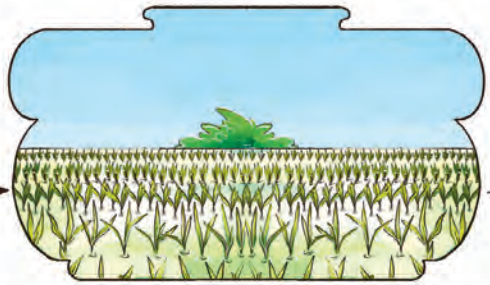
3. Collect algae



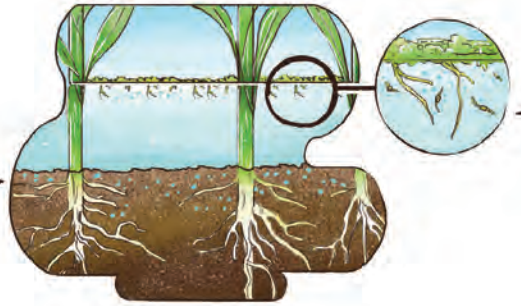
4. Deposit algae



5. Algae will grow



6. Algae associates with microbes to produce natural nitrogen fertilizer



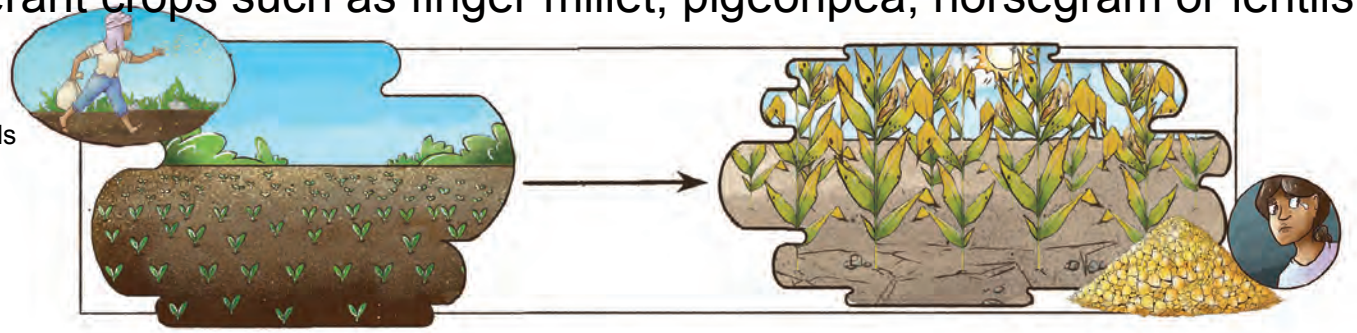
7. Good yield with fewer bags of artificial nitrogen fertilizer needed

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Chapter 6: **Water**

Lesson: If the climate is becoming dryer, then shift from traditional crops such as maize or rice to drought tolerant crops such as finger millet, pigeonpea, horsegram or lentils

1. Traditional practice may be to grow maize or rice but yields are low when rain is low



2. Select drought tolerant crops

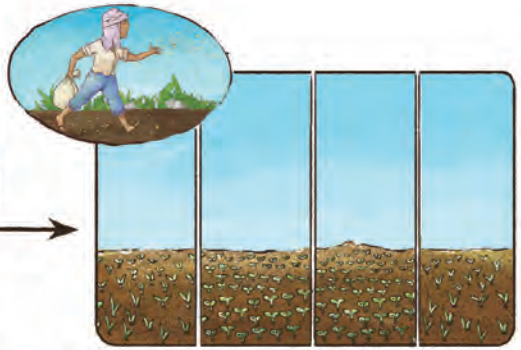
finger millet

Pigeonpea

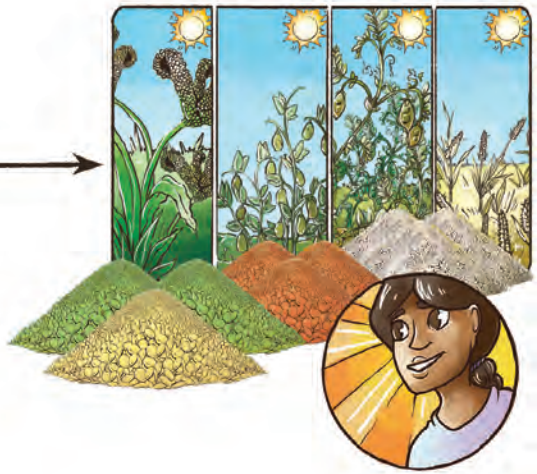
Horsegram

lentil

3. Purchase seed from vendor

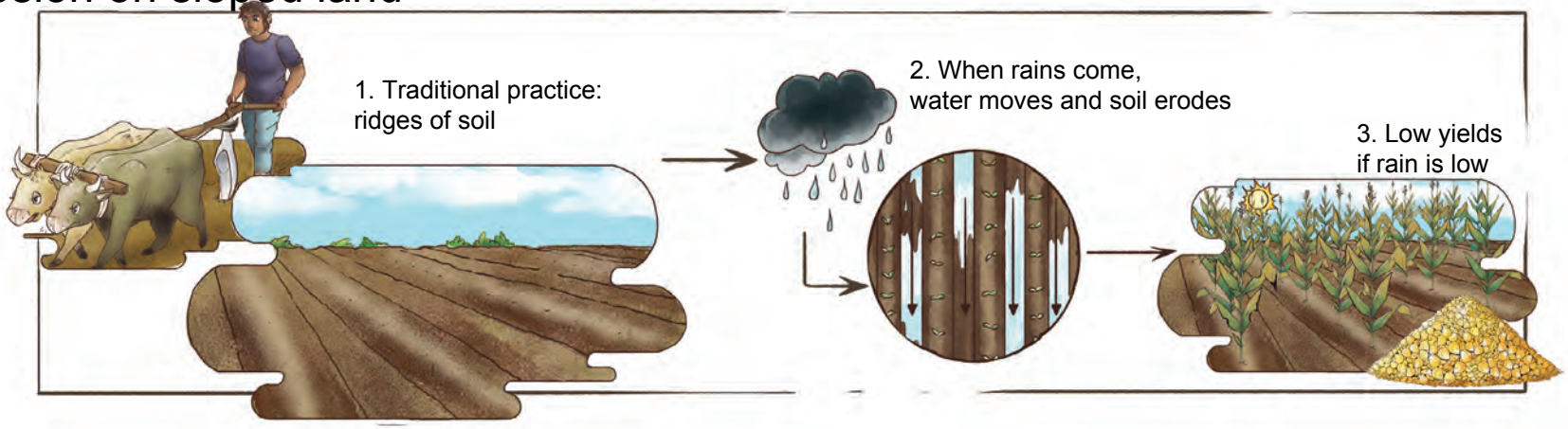


4. Good yields with low rainfall

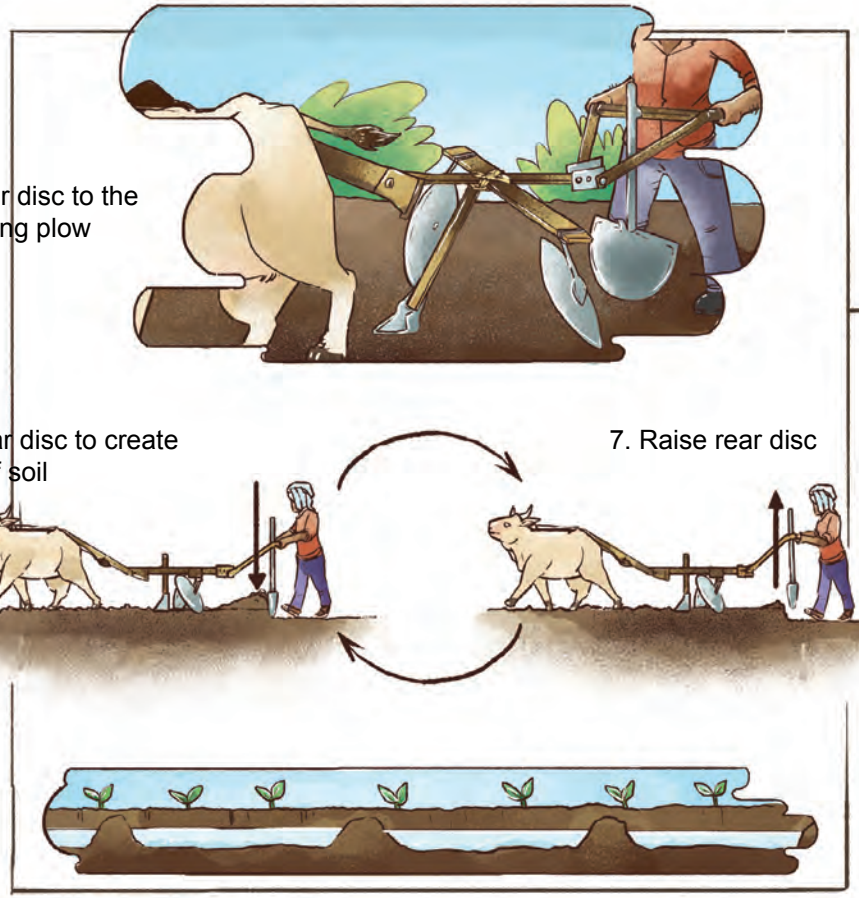


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

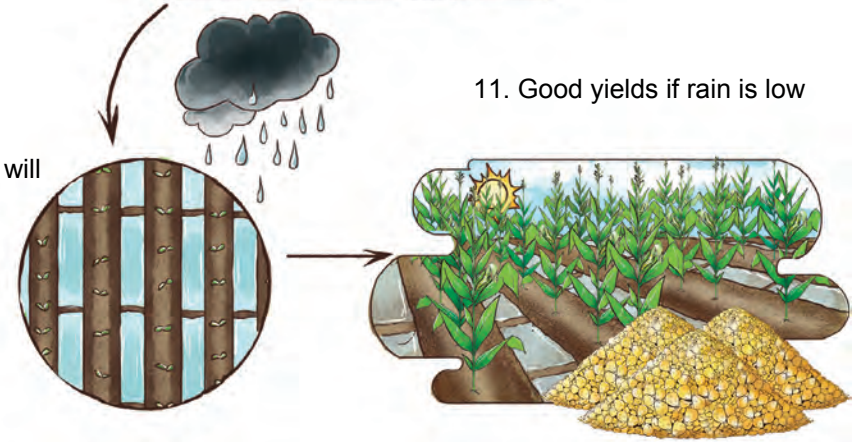
Lesson: Connecting soil ridges with small walls of soil can conserve rainwater and reduce soil erosion on sloped land



4. Improved practice

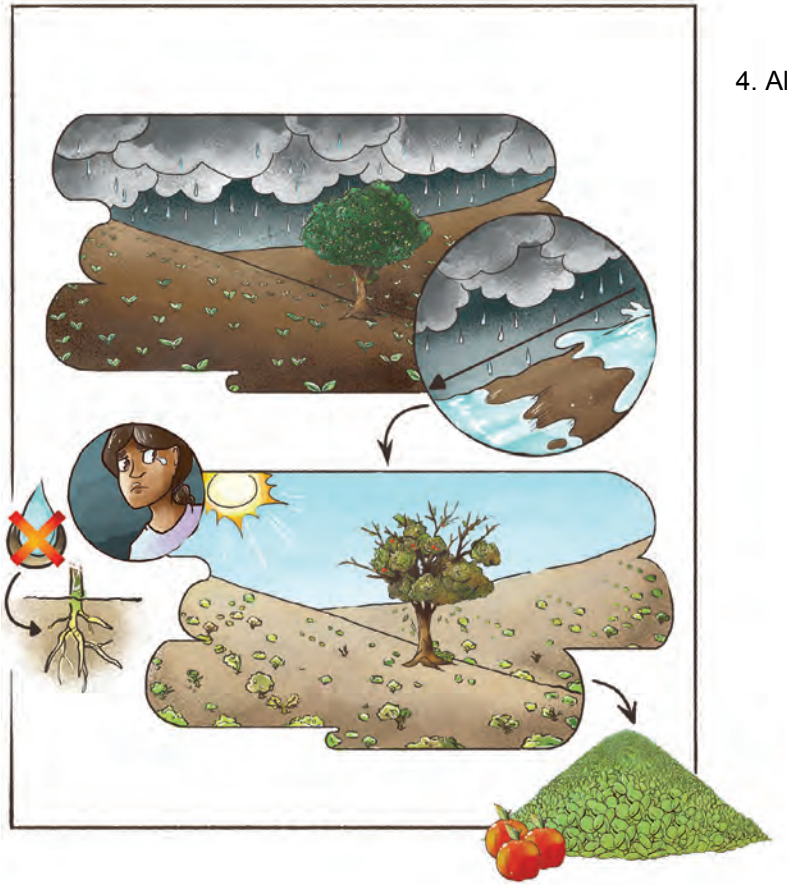


9. Result will be rows of ridges, connected by small walls



Lesson: There are simple methods to collect rainwater on slightly sloped land for dry season

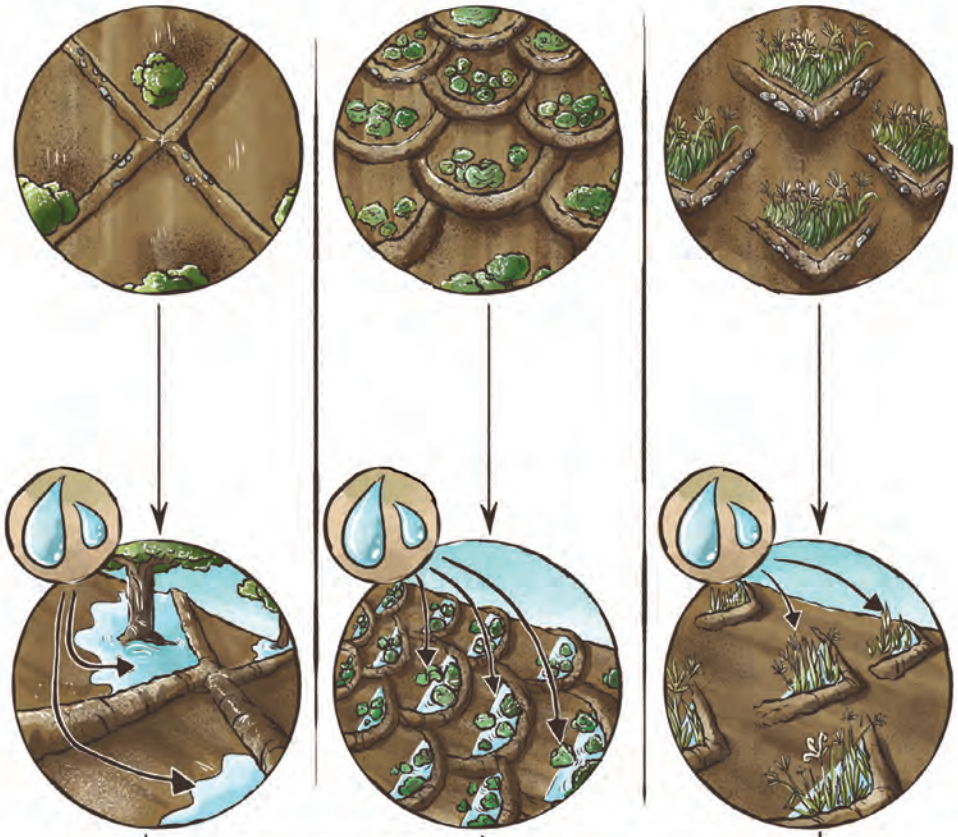
1. Traditional practice: water is lost



2. Low yields when rain is low (e.g. apple)

3. Improved practice: create soil bund that surrounds fruit tree to collect rainwater

4. Alternative designs

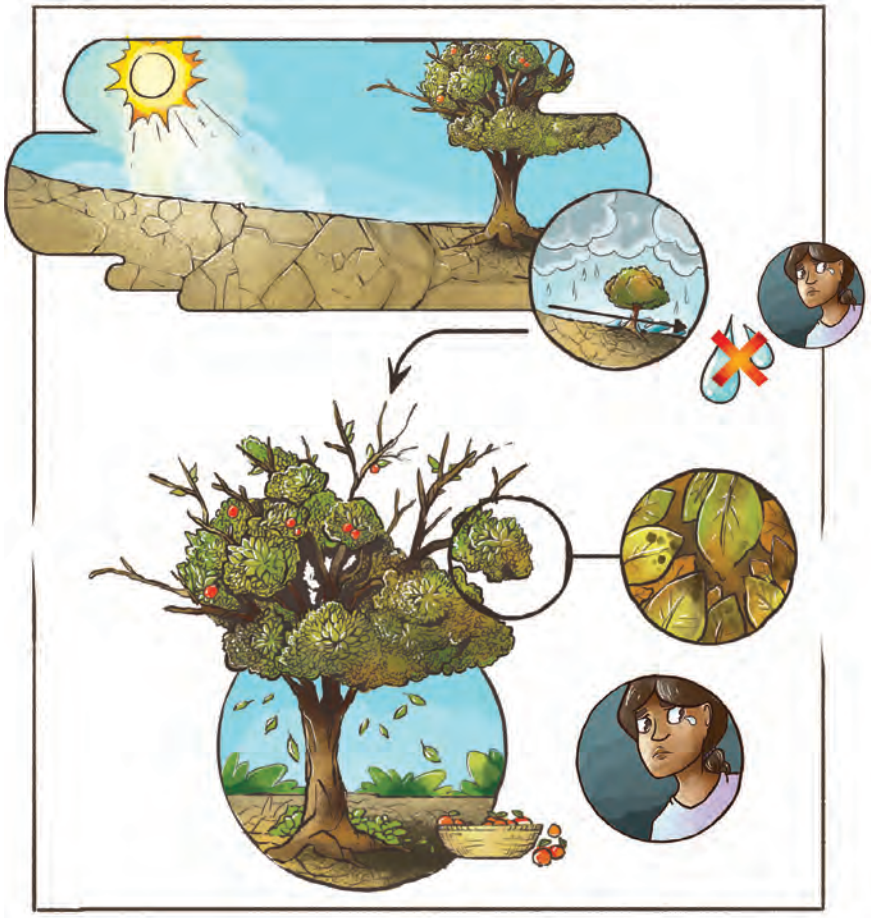


5. Improved yields

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

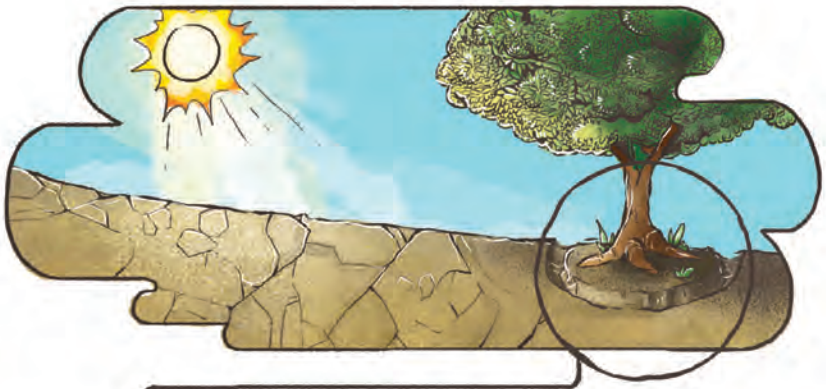
Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using a bund or pit

1. Traditional practice: no water collected

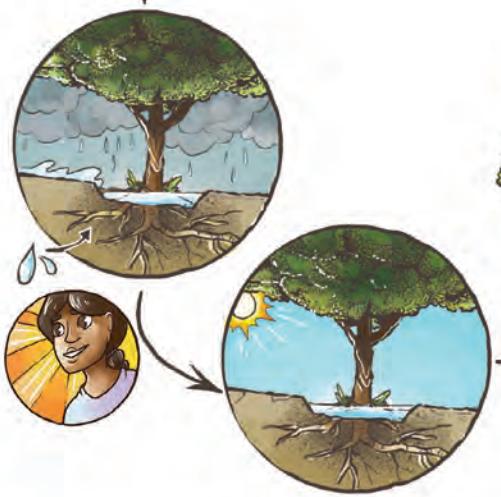


2. Low fruit yield (e.g. apple)

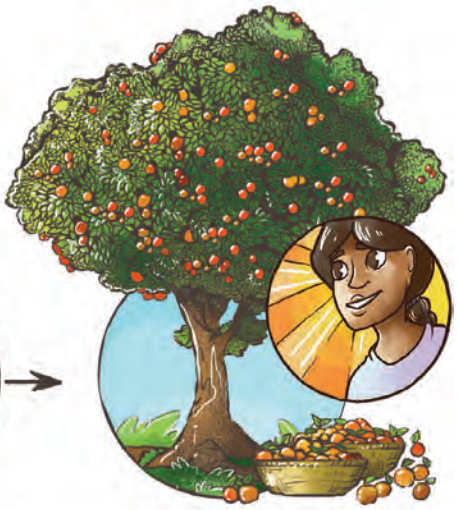
3. Improved practice: create short wall or pit around tree



4. Rain collected

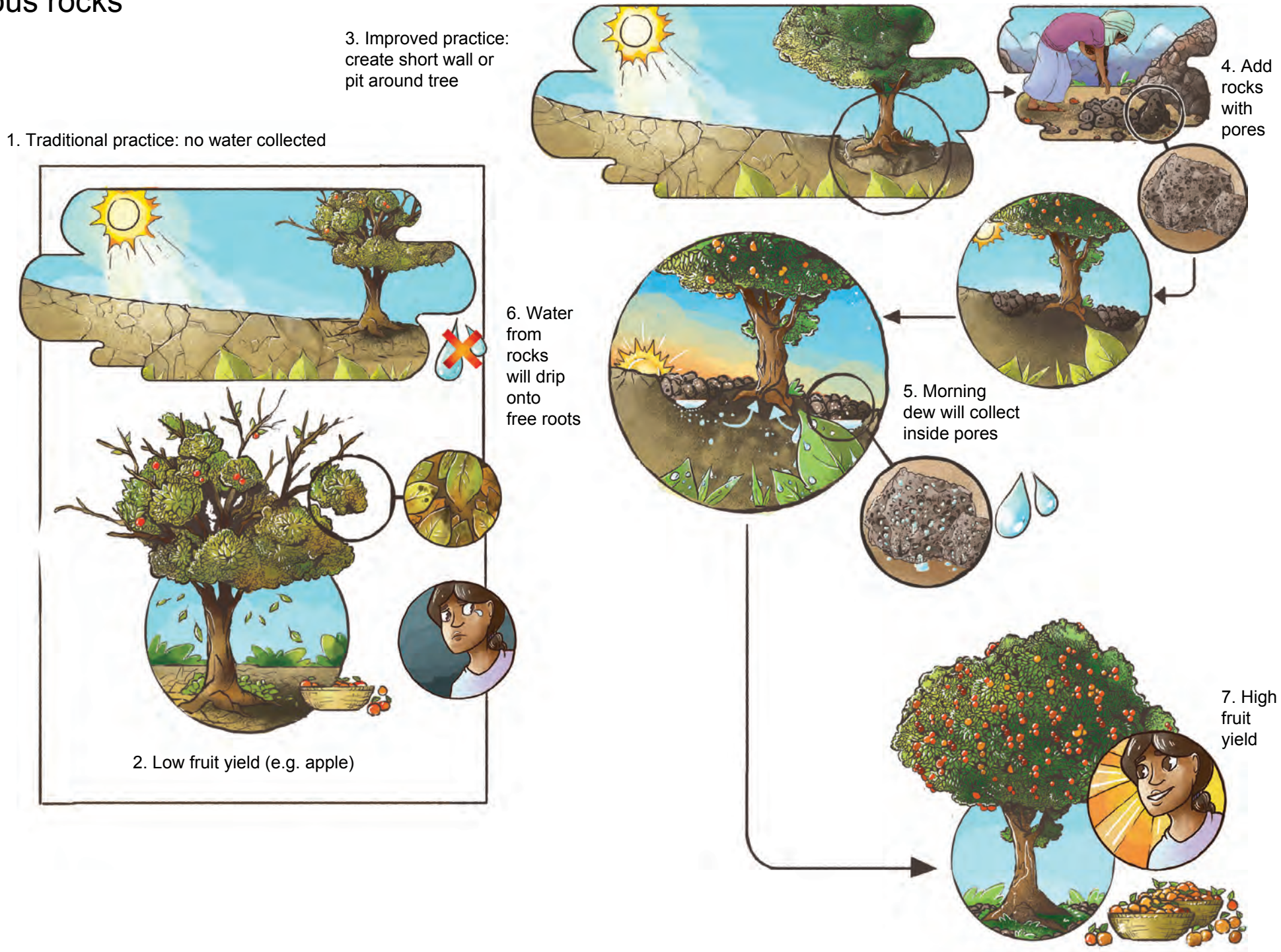


5. High fruit yield

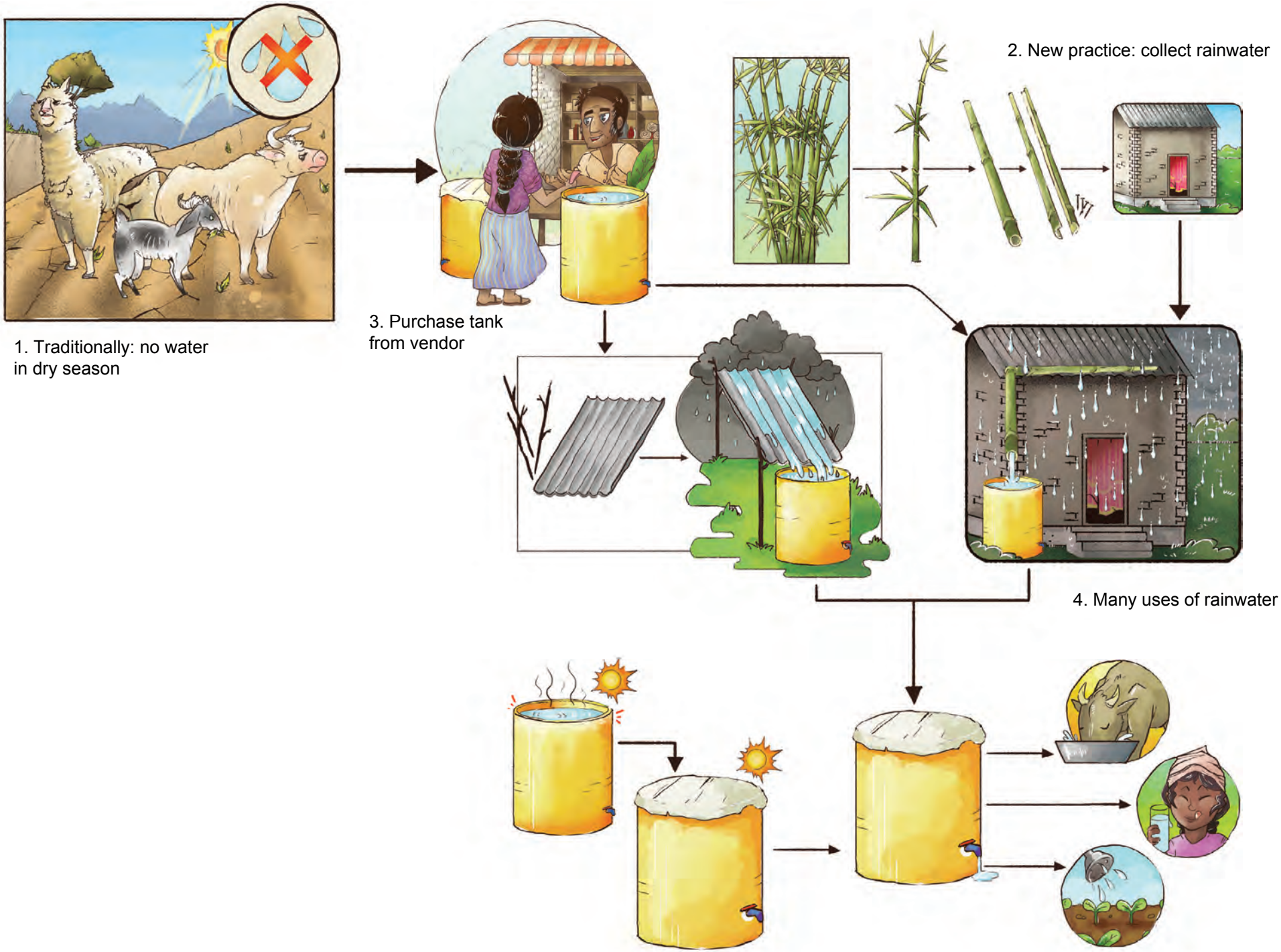


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using porous rocks



Lesson: Rainwater can be collected

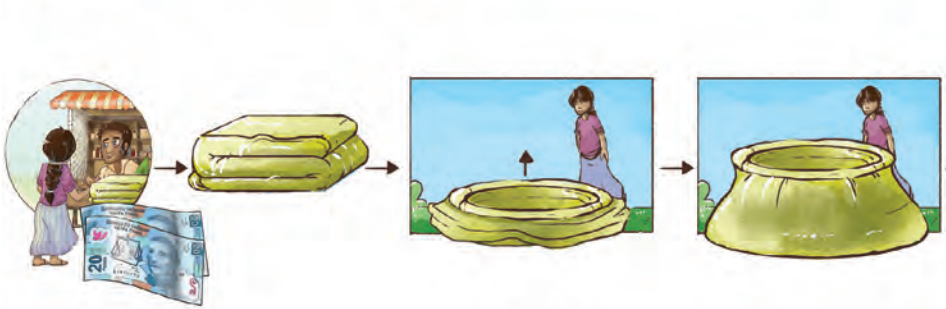


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Cheap foldable plastic tanks or tarpaulins can be used to collect rainwater

1. Traditional situation: rainfall is lost

2. In dry season, no water

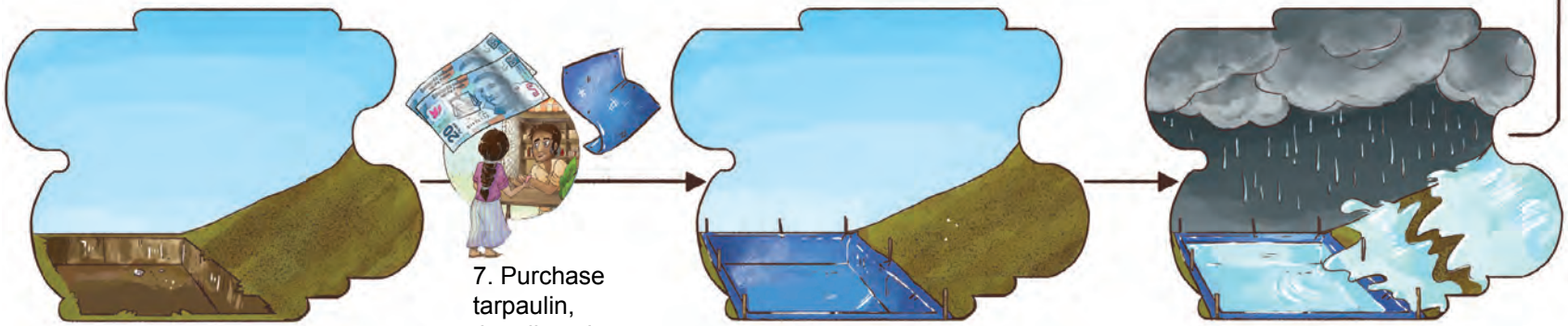


3. New practice is to purchase folding plastic water tank

4. Collect rainwater

5. Many uses of rainwater

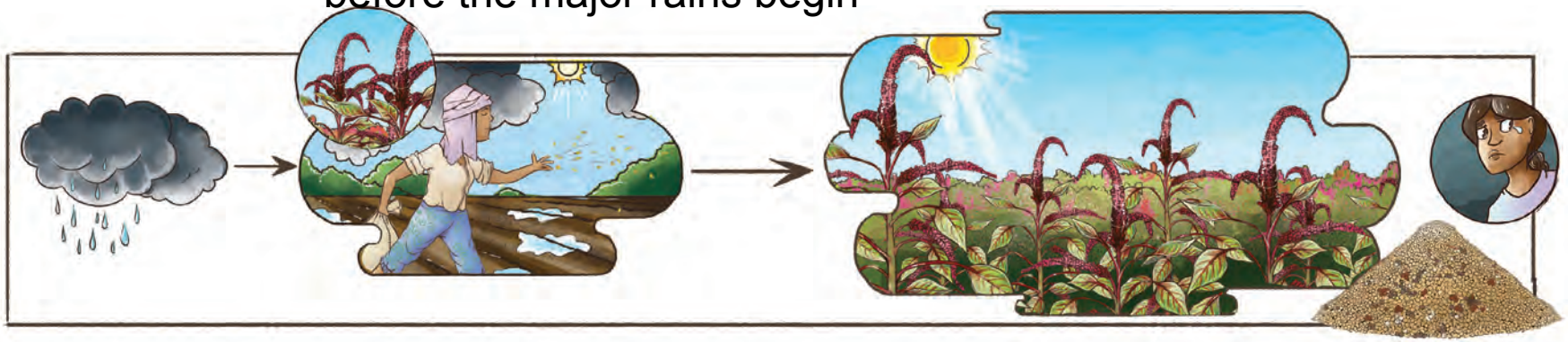
6. Second new practice is to dig pit at bottom of hill.



7. Purchase tarpaulin, then line pit

8. Collect rainwater in pit

Lesson: Collected rainwater can be used to irrigate a millet nursery in order to enable sowing before the major rains begin

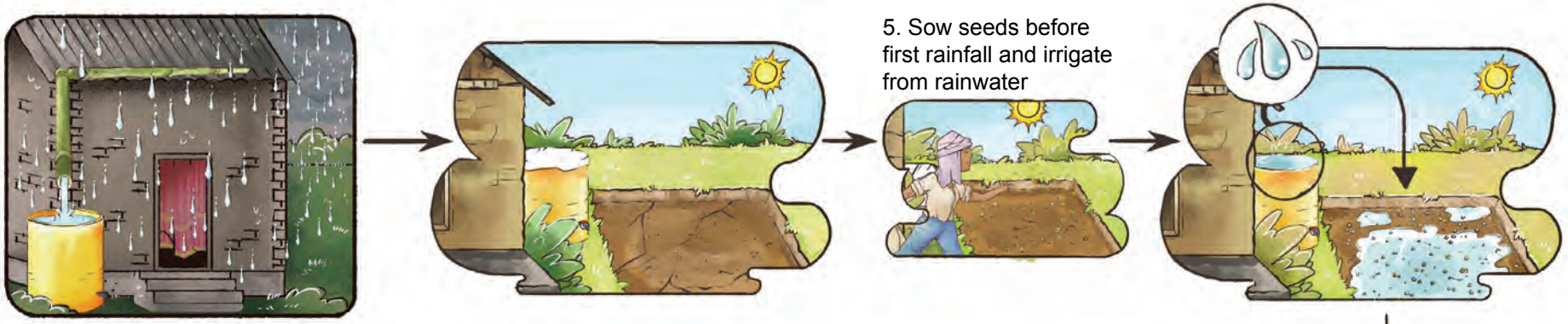


1. Traditional practice is to sow millet seeds after first rainfall

2. If growing season is short, then yield is low.

4. Prepare nursery at end of dry season

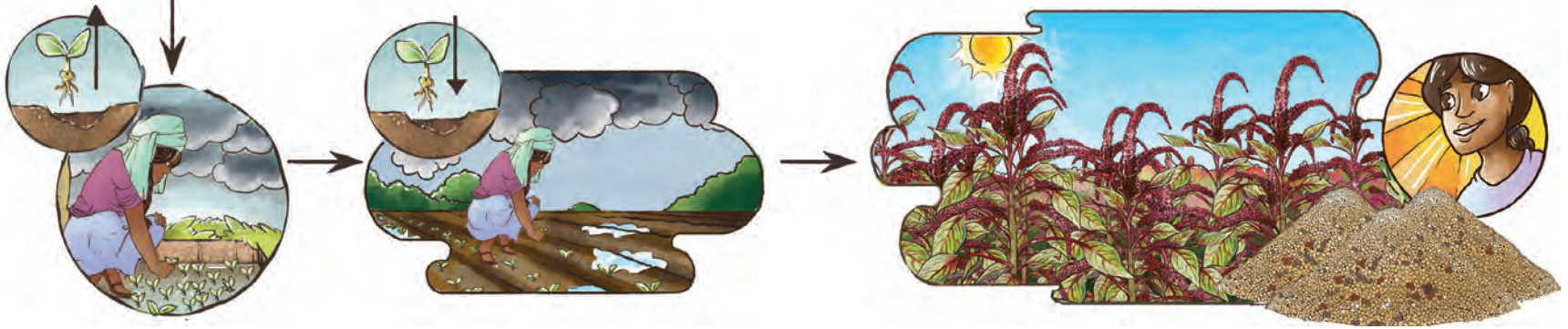
5. Sow seeds before first rainfall and irrigate from rainwater



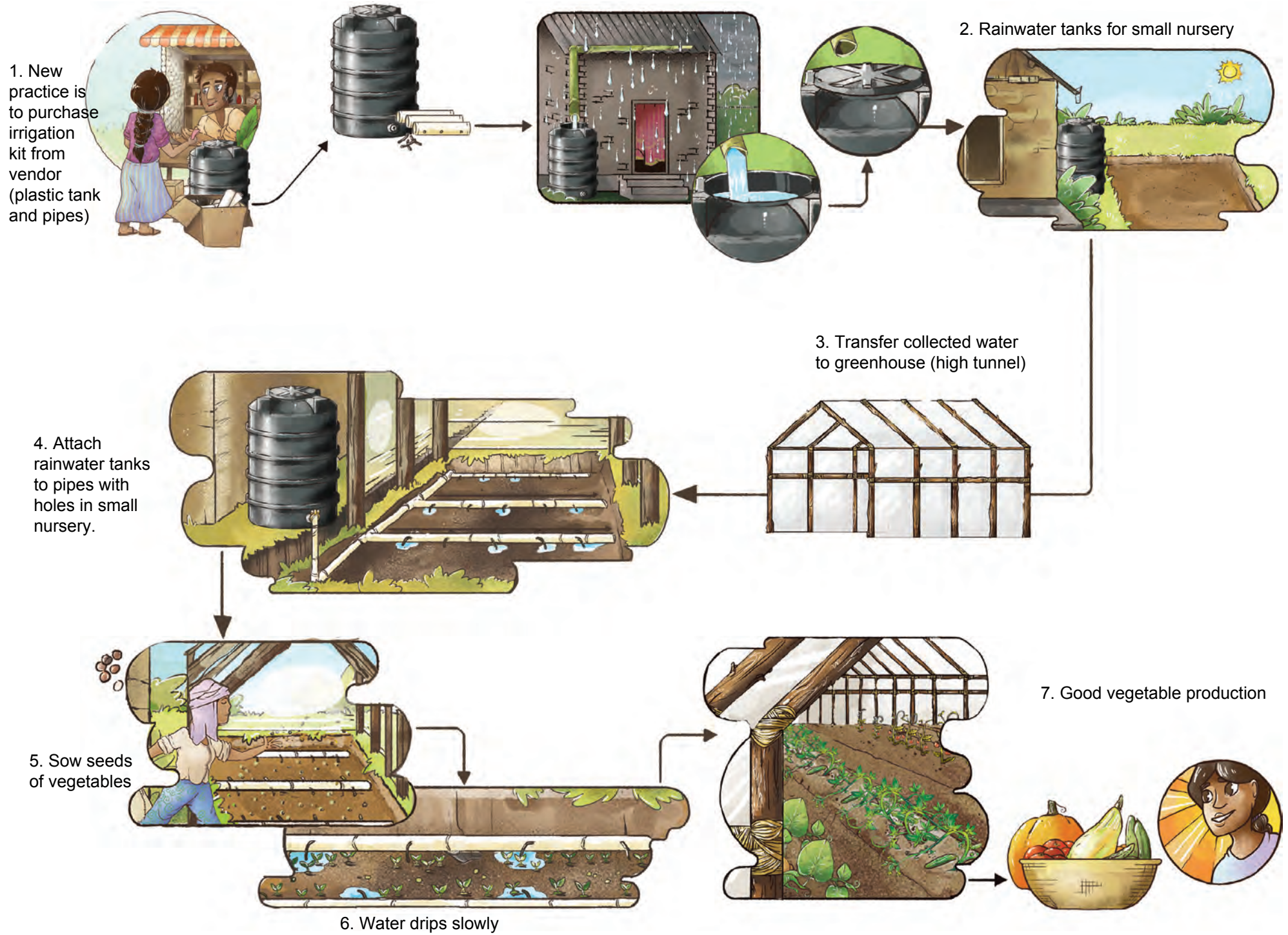
3. New practice is to collect rain during rainy season.

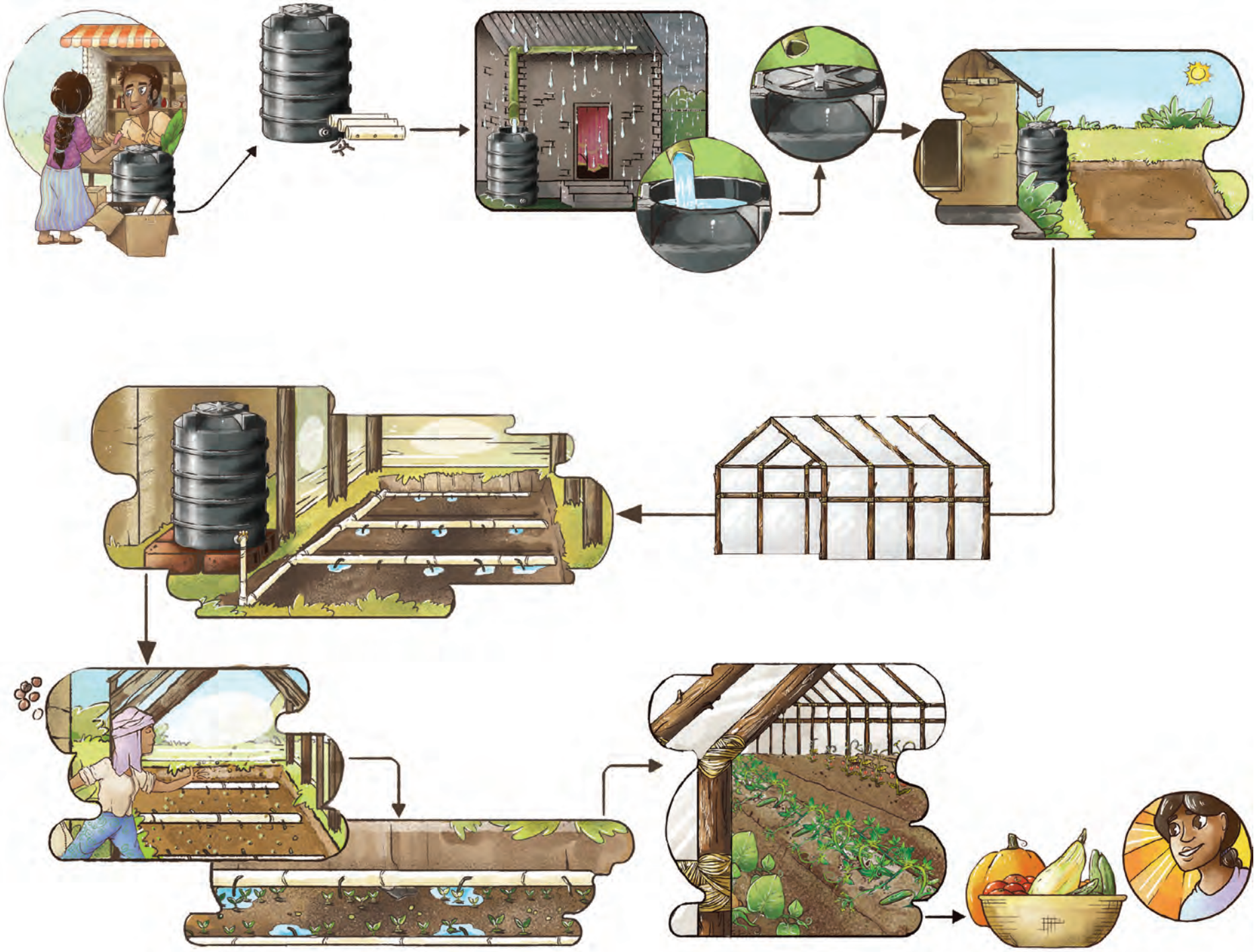
6. When rains arrive, transplant seedlings to the field

7. Yield is higher because the crop duration was increased



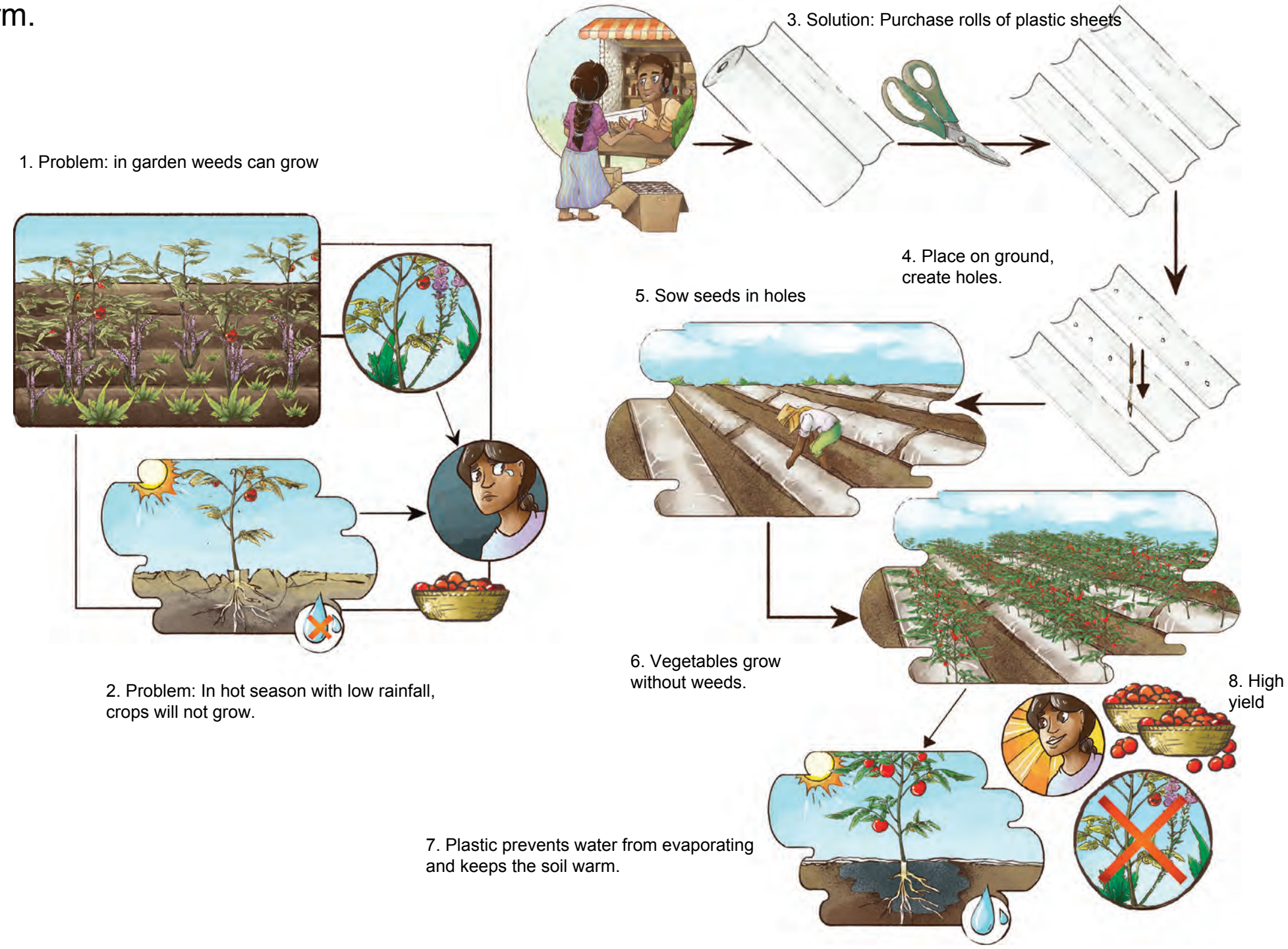
Lesson: Collected rainwater can be connected to pipes with holes to feed water directly to roots





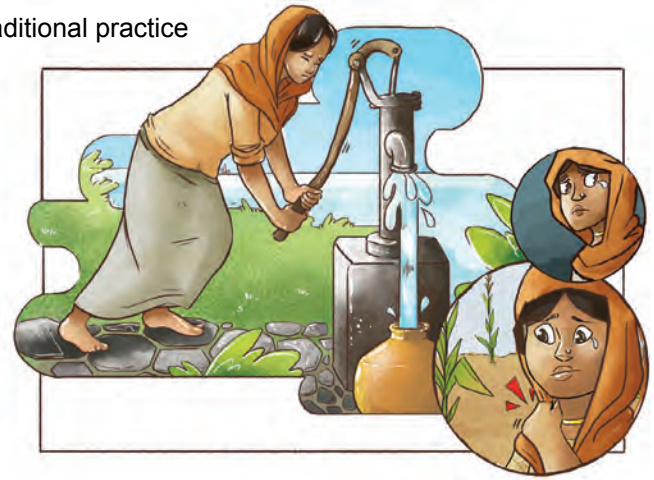
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Use plastic mulch to suppress weeds in the garden, prevent water loss and keep soil warm.

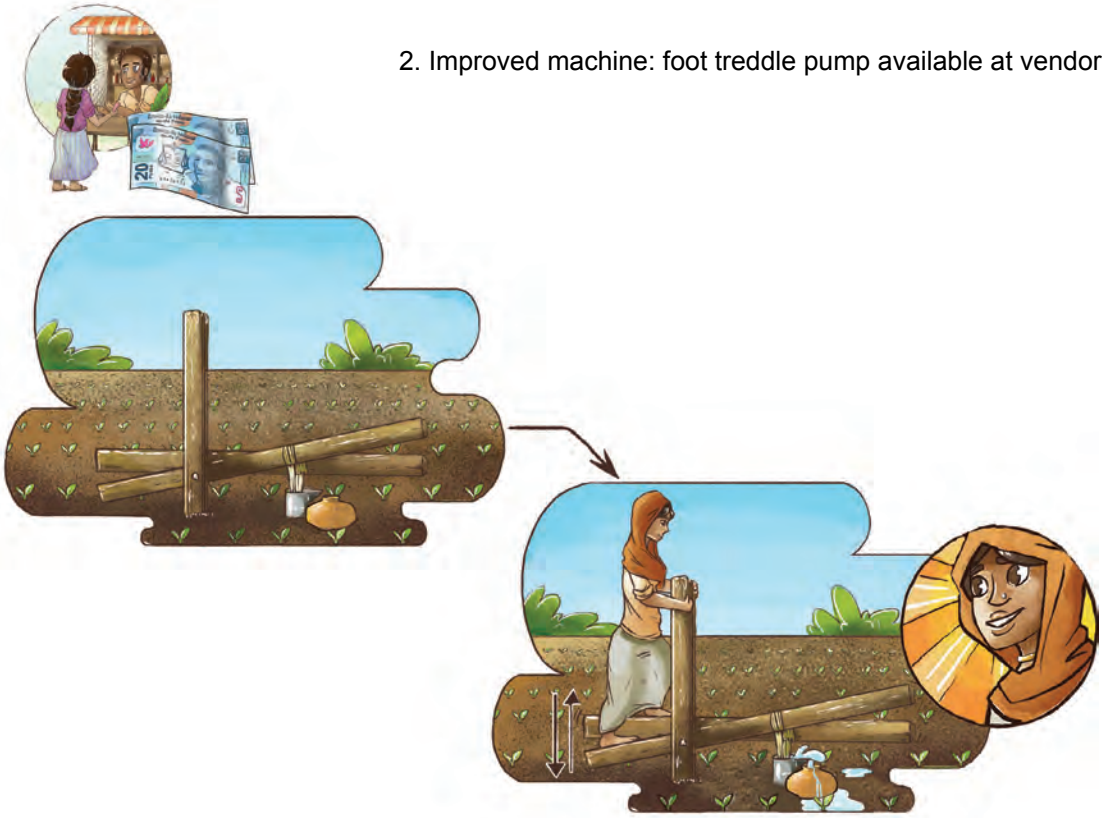


Lesson: There are improved machines to pump water from a well that reduce labour

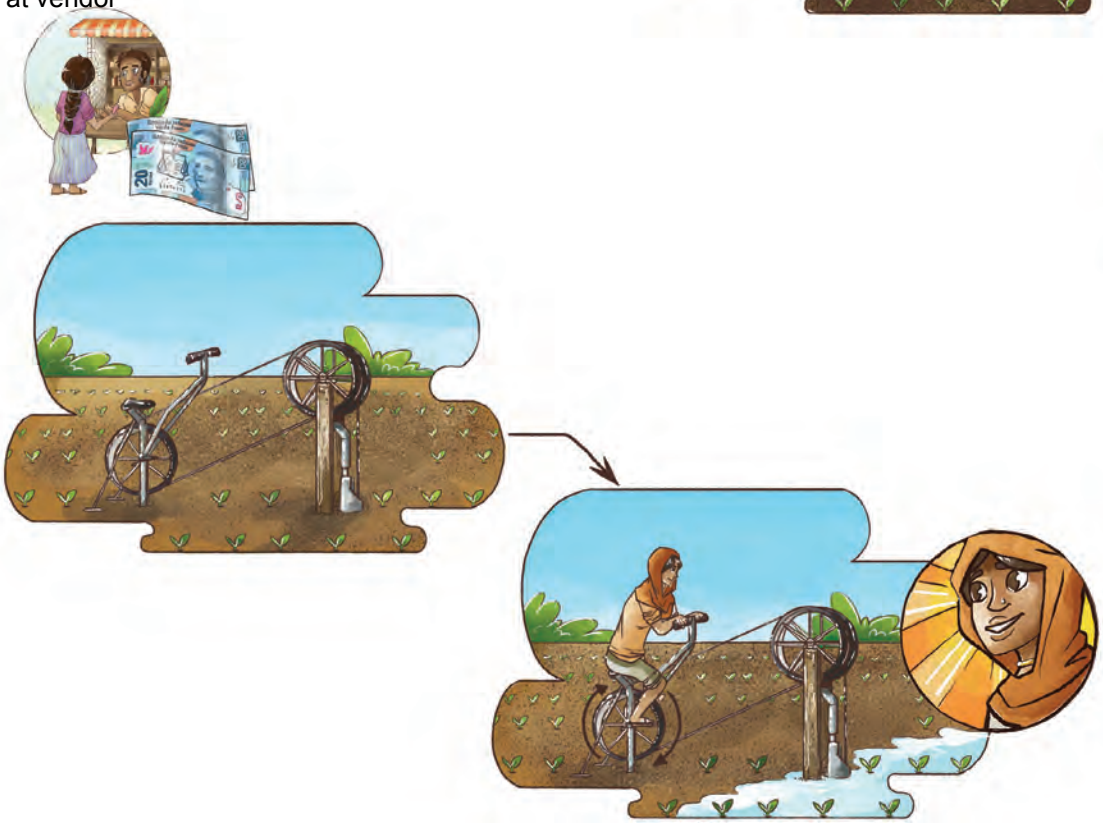
1. Traditional practice



2. Improved machine: foot treddle pump available at vendor



3. Alternative improved machine: bicycle pump available at vendor



Chapter 7: **Weeds**

Lesson: Kneepads can reduce pain at knees and prevent knees from becoming wet or cold such as during weeding

1. Traditional practice causes cold, pain on knees

2. New practice

3. Purchase from vendor

Lesson: New tools to reduce drudgery of hand removal of weeds

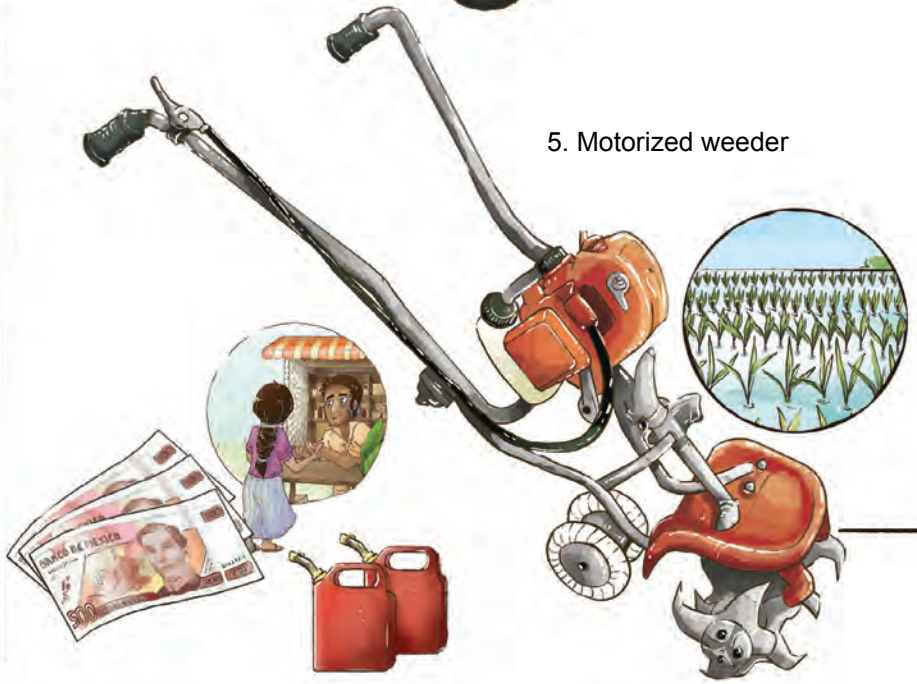
1. Traditional practice

2. Removing weeds by hand is slow and causes back pain due to bending over.

3. New weeding tools: ask nearby vendor to supply or ask local blacksmith to construct

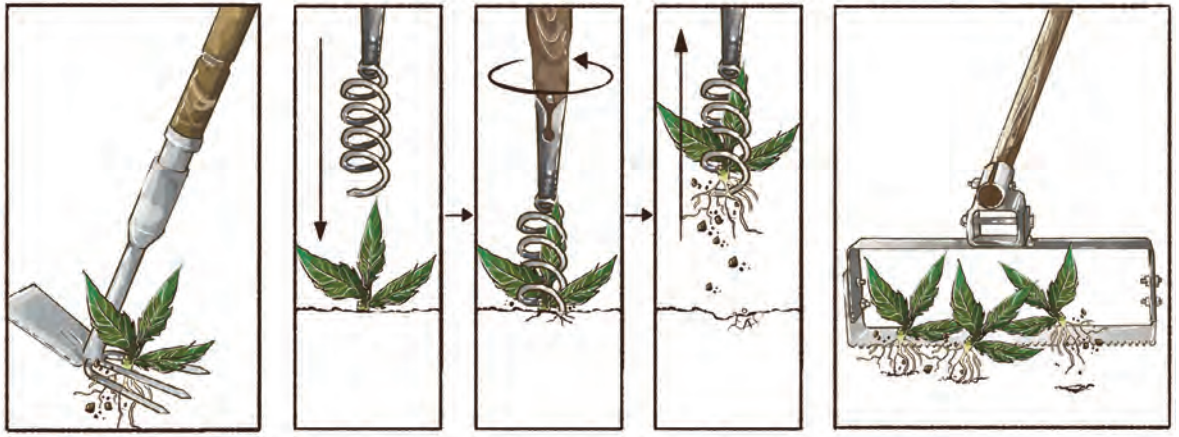
4. Wheel hoe

5. Motorized weeder

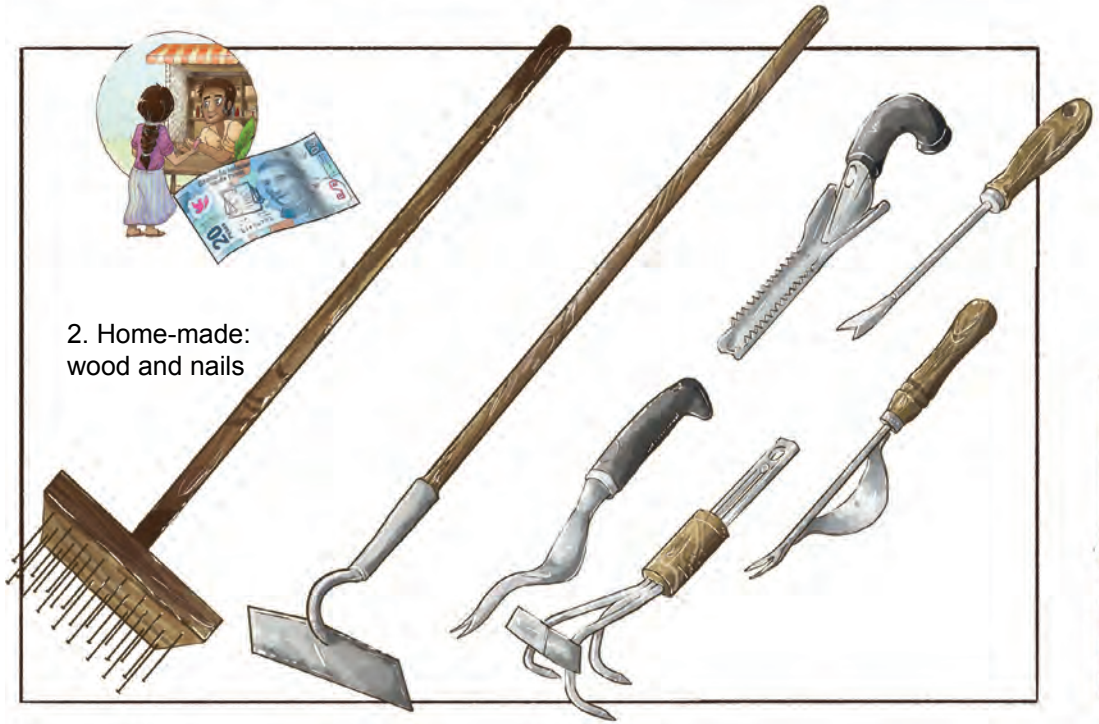


Lesson: New tools to reduce drudgery of hand removal of weeds: Long-handled, medium cost options.

1. Long handled weeders



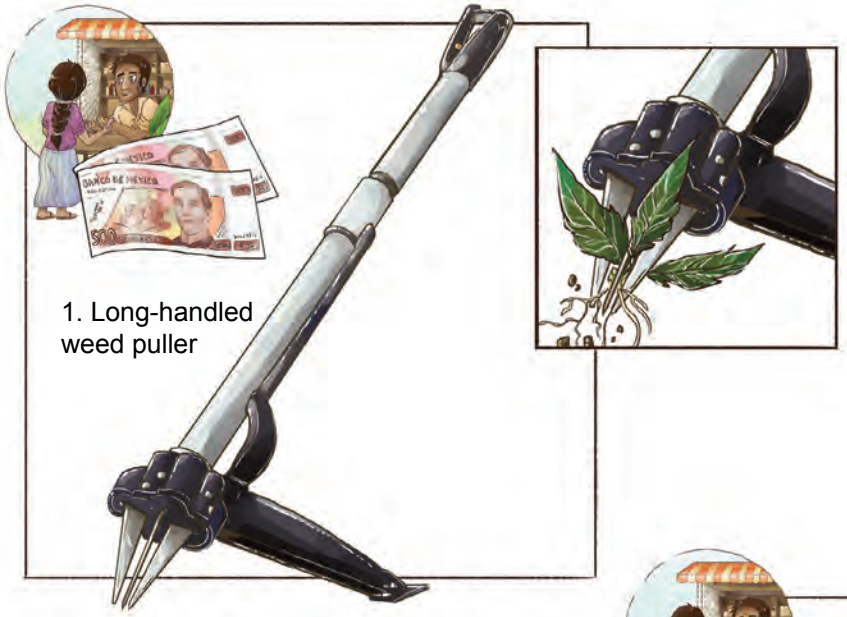
3. Short handled weeders



2. Home-made: wood and nails

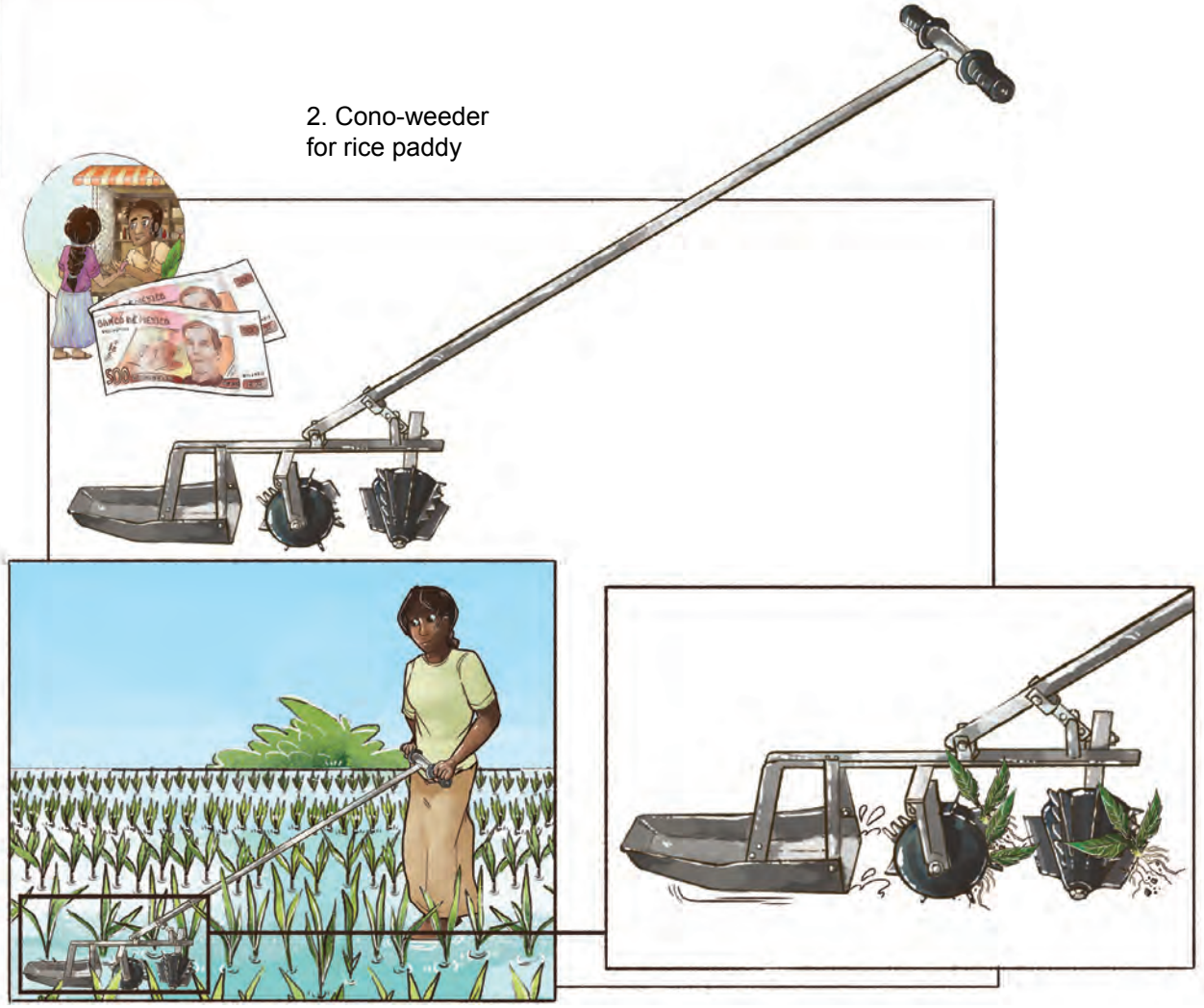
4. How to use

Lesson: New tools to reduce drudgery of hand removal of weeds:Expensive options.



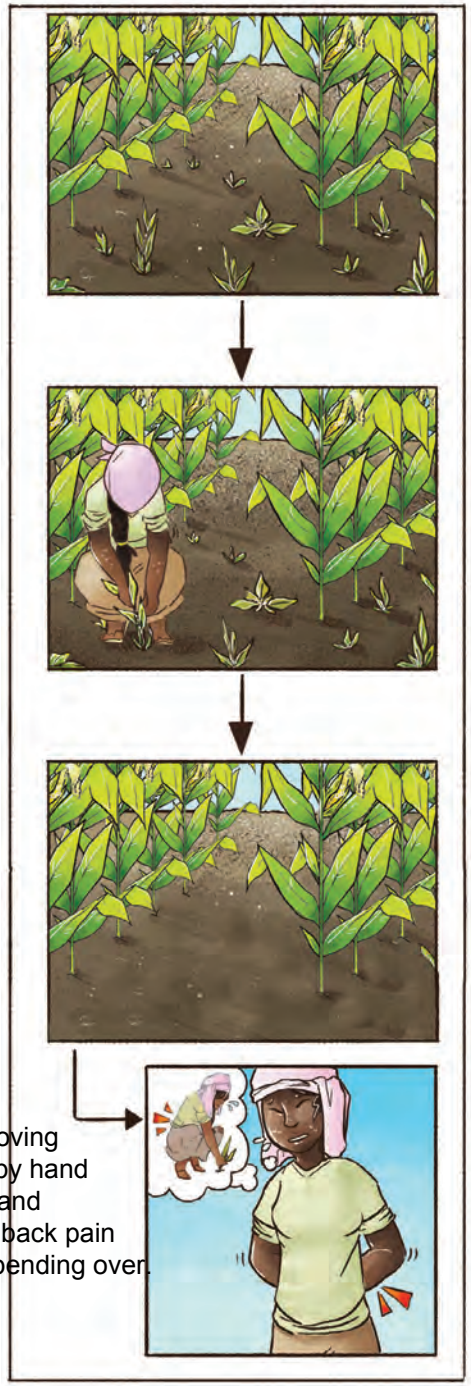
1. Long-handled weed puller

2. Cono-weeder for rice paddy



Lesson: New tool to reduce drudgery of hand removal of weeds: Fork weeder.

1. Traditional practice



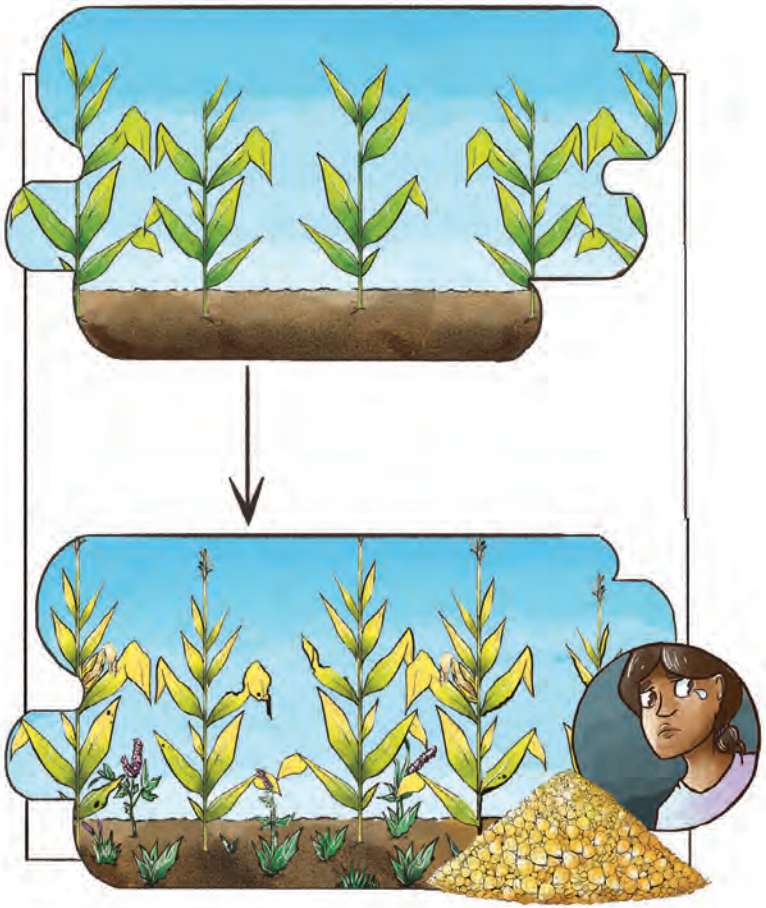
2. Removing weeds by hand is slow and causes back pain due to bending over.

3. New tool: fork weeder available at vendor

4. Remove weeds easily

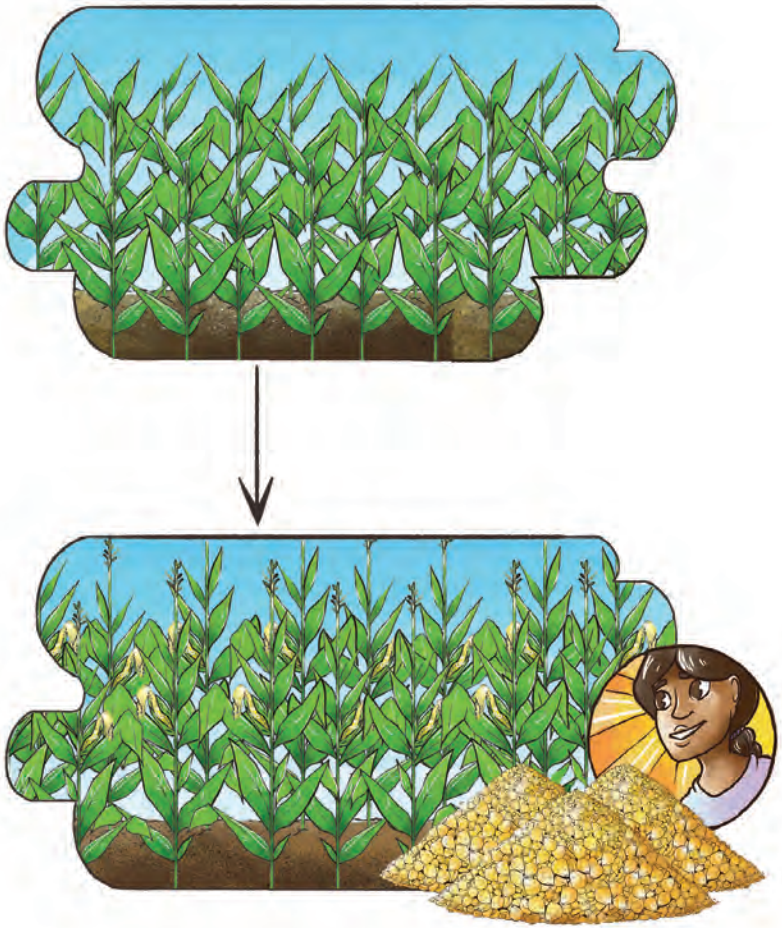
Lesson: Sowing crops at a high density can suppress weeds

1. Traditional practice: sowing crops in rows with wide spacing



2. Weeds grow, low yields

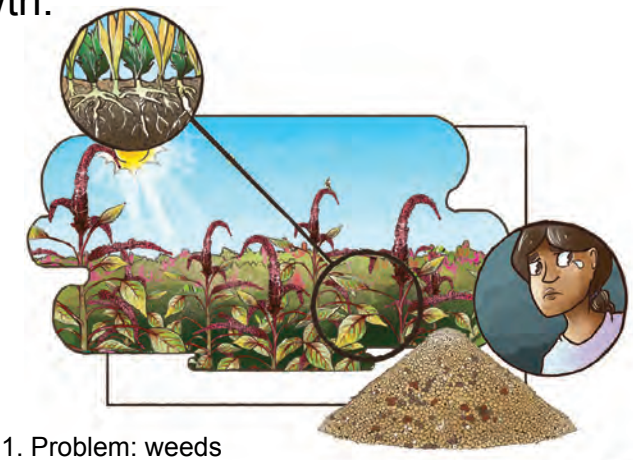
3. Improved practice: sow crops in rows with very narrow spacing



4. Fewer weeds, higher yields

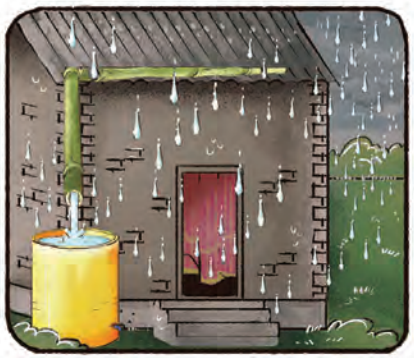
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

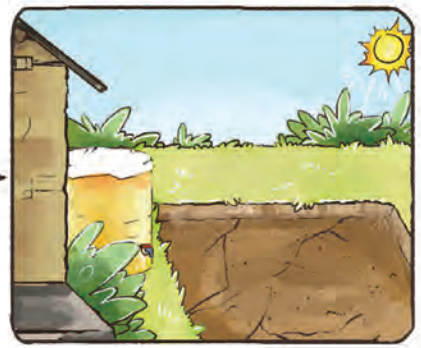
Lesson: Sowing finger millet in a nursery using irrigated water, followed by transplanting, can reduce the weed growth.



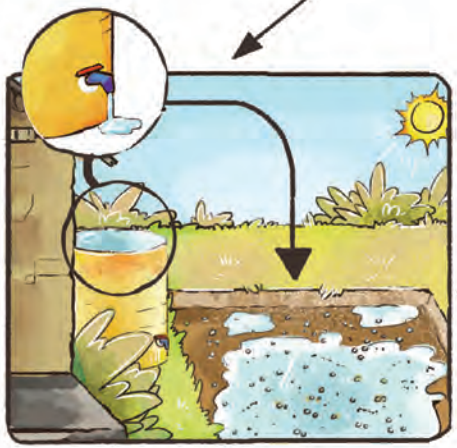
1. Problem: weeds (red flower) reduce yield of millet

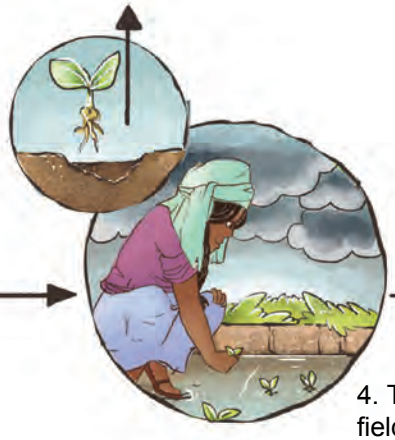
2. Improved practice



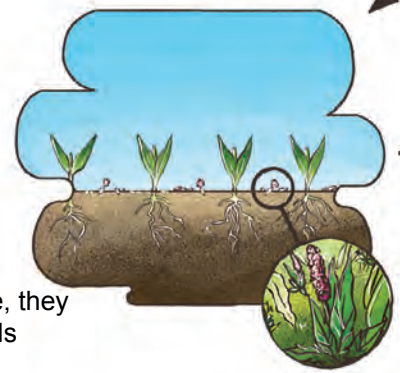


3. Sow millet seedlings at end of dry season in a nursery and use harvested rainwater for irrigation





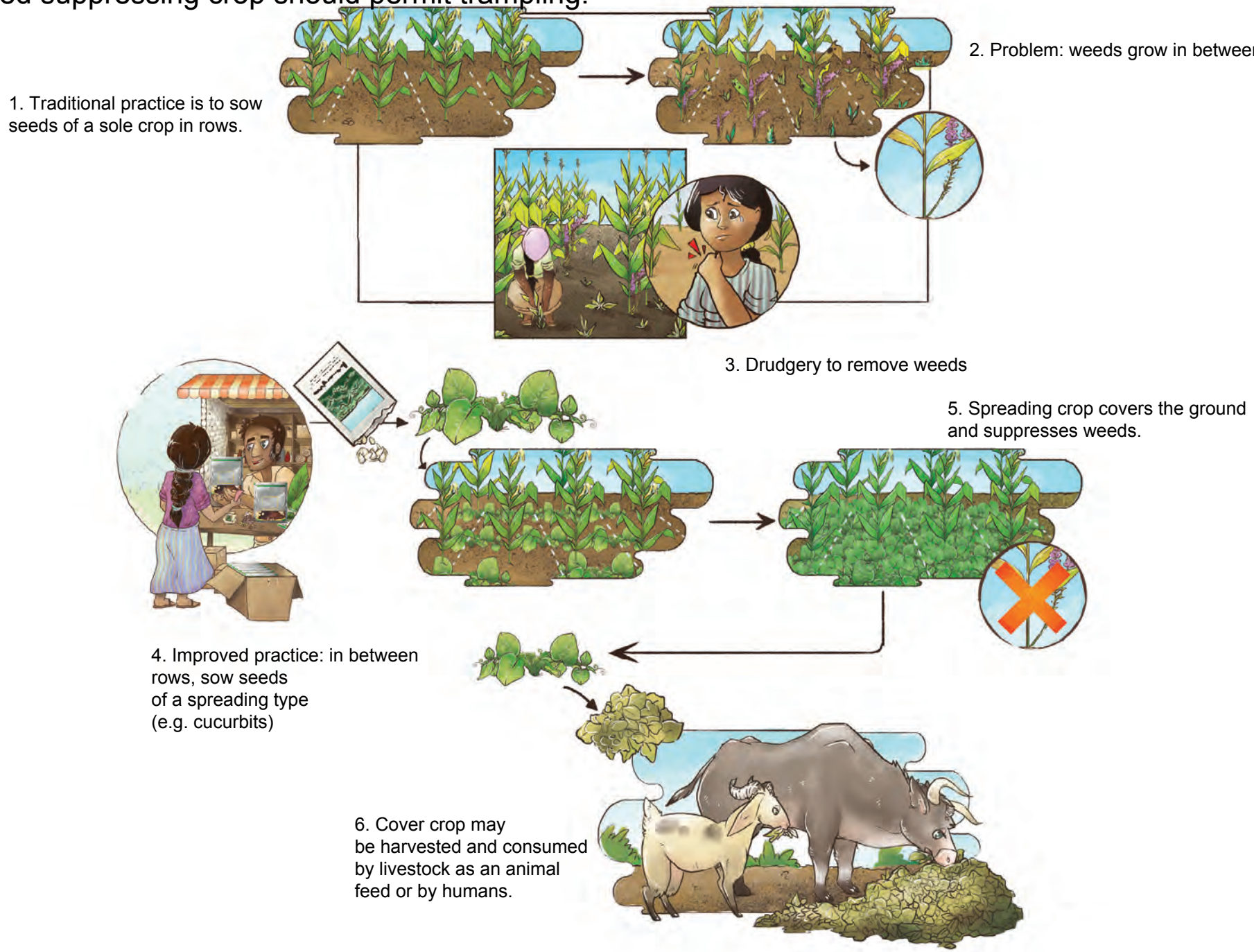
4. Transplant seedlings to field at start of rainy season



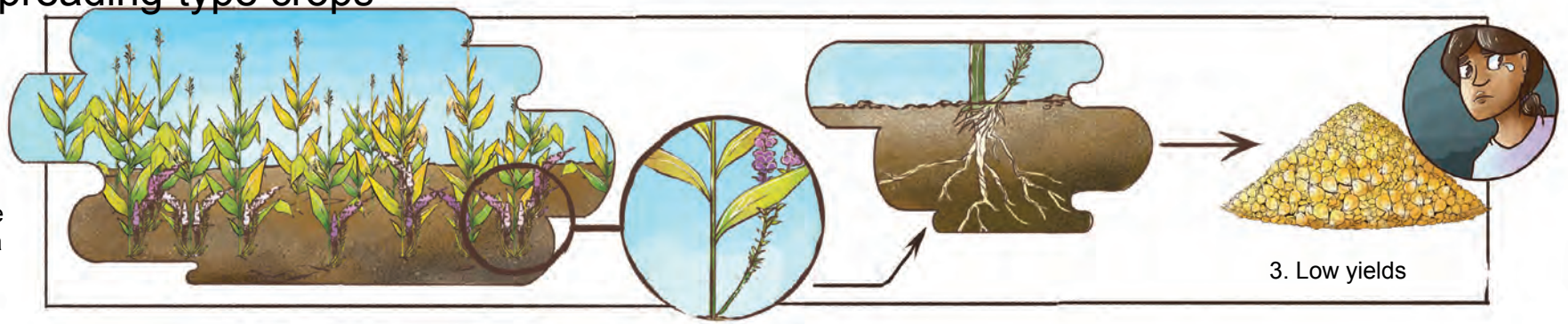
5. Since millet plants are large, they outcompete germinating weeds

6. High grain yields

Lesson: To suppress weeds, sow seeds of a spreading type crop or forage in between rows of the major crop. The weed suppressing crop should permit trampling.



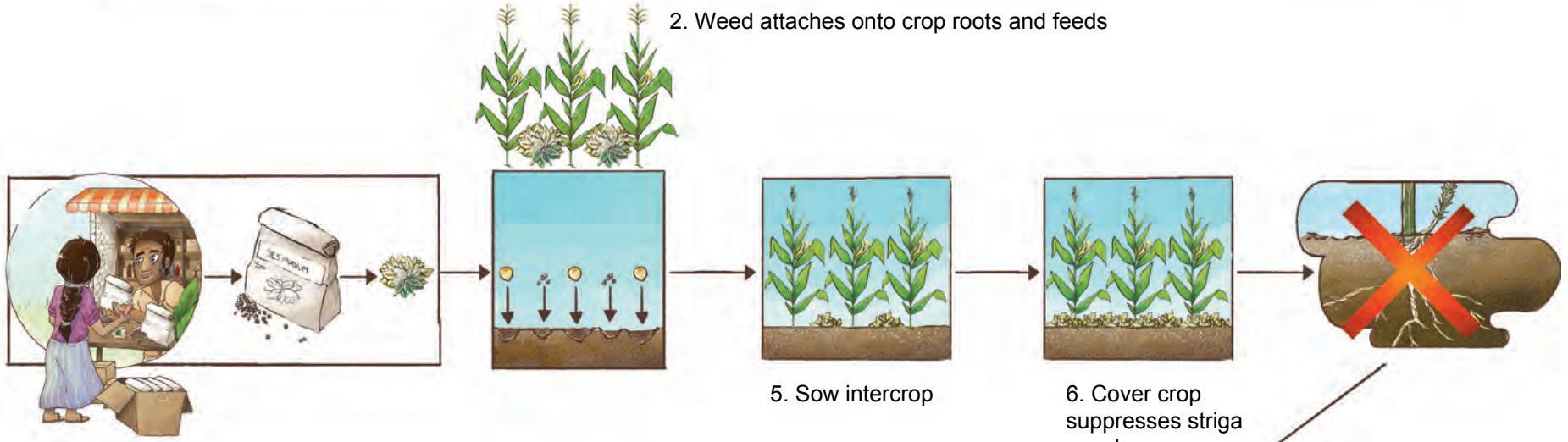
Lesson: Parasitic striga weed can be suppressed by intercropping with Desmodium or other spreading-type crops



1. Traditional practice: no cover crop - purple or white flowered striga weed grows

2. Weed attaches onto crop roots and feeds

3. Low yields



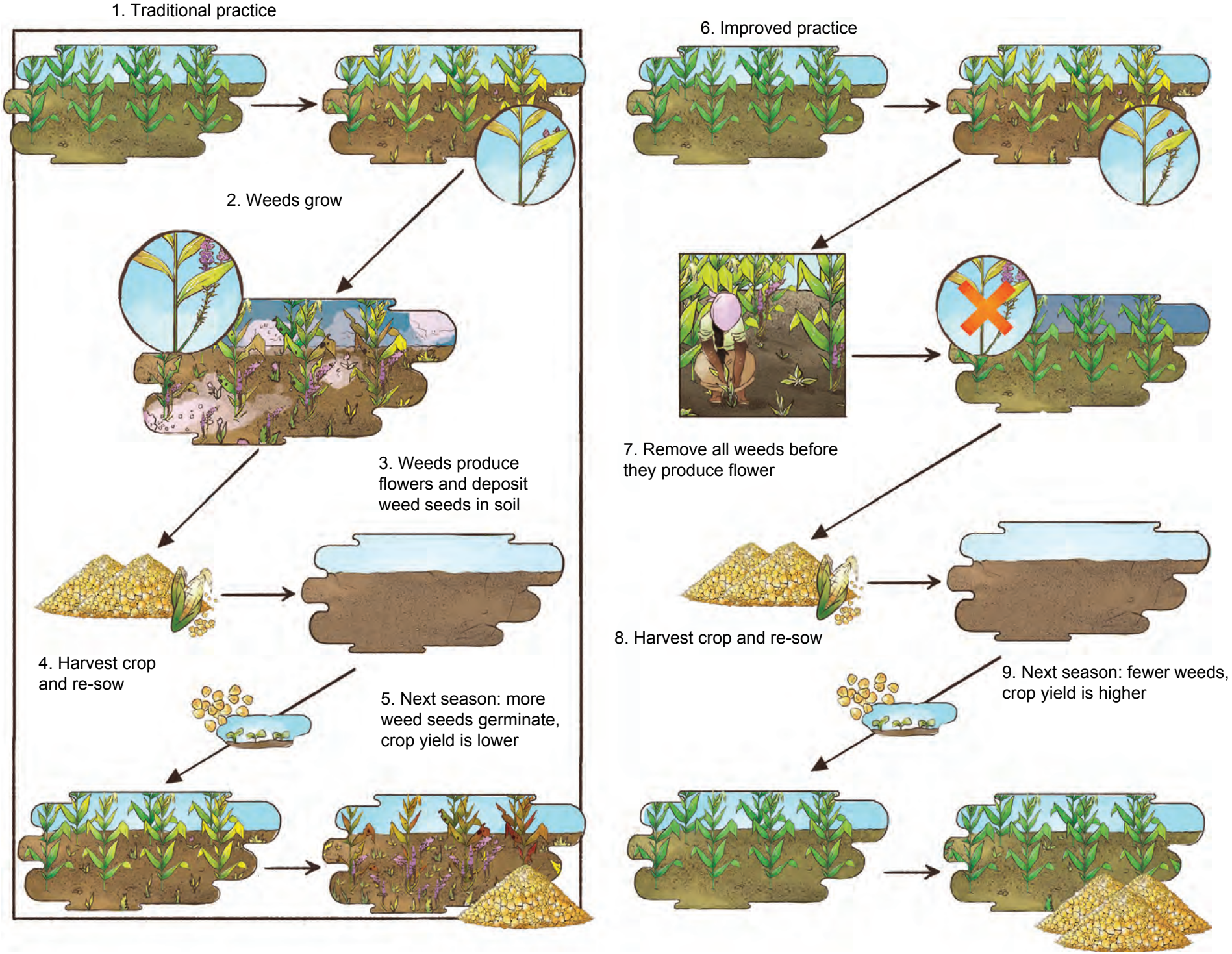
4. Improved practice: purchase Desmodium seed or other spreading-type seed from vendor

5. Sow intercrop

6. Cover crop suppresses striga weed

7. High yields. Desmodium also adds natural nitrogen fertilizer to soil and can be used as livestock feed

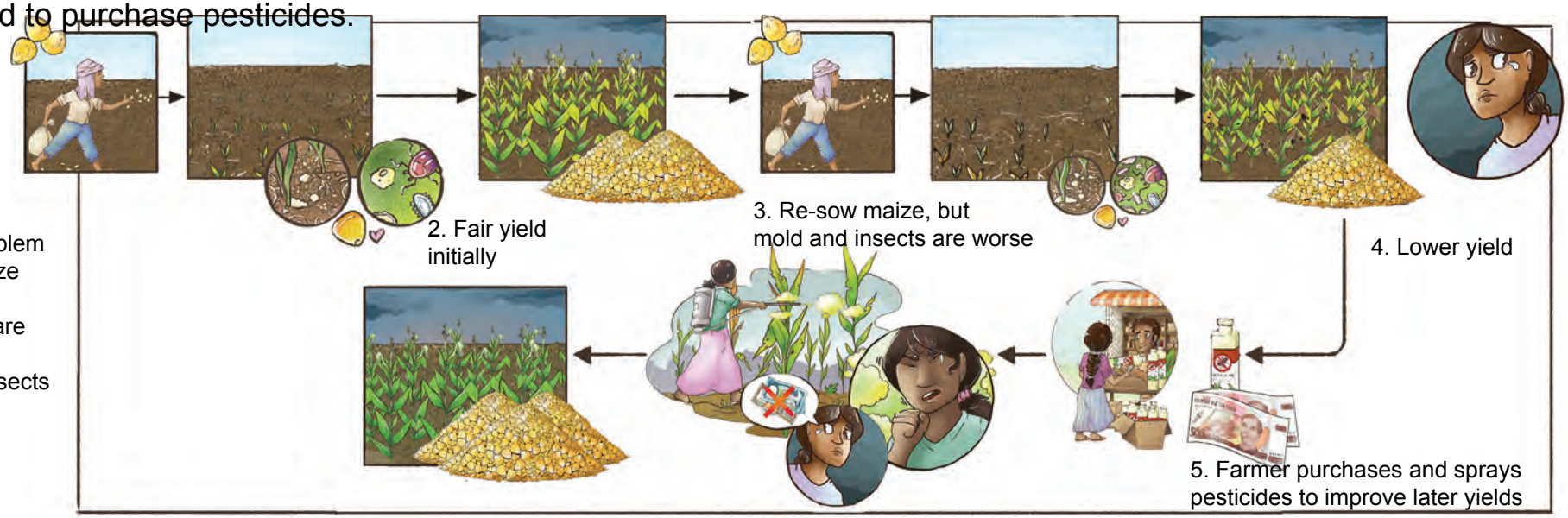
Lesson: Removing weeds before they produce flowers will reduce weeds in future years

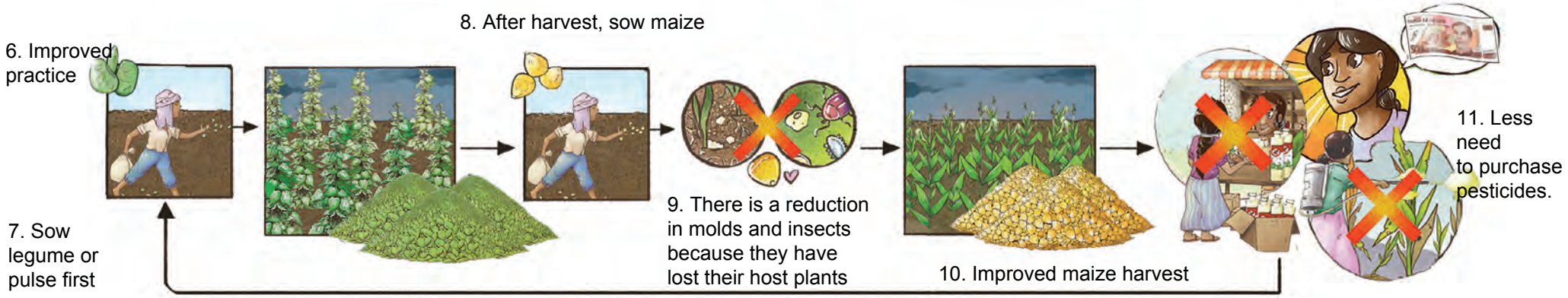


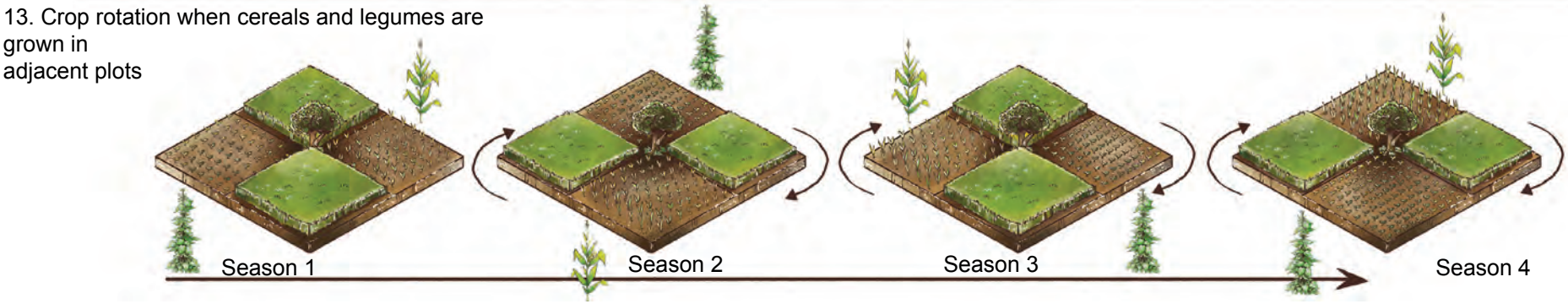
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Chapter 8: **Pests & Disease**

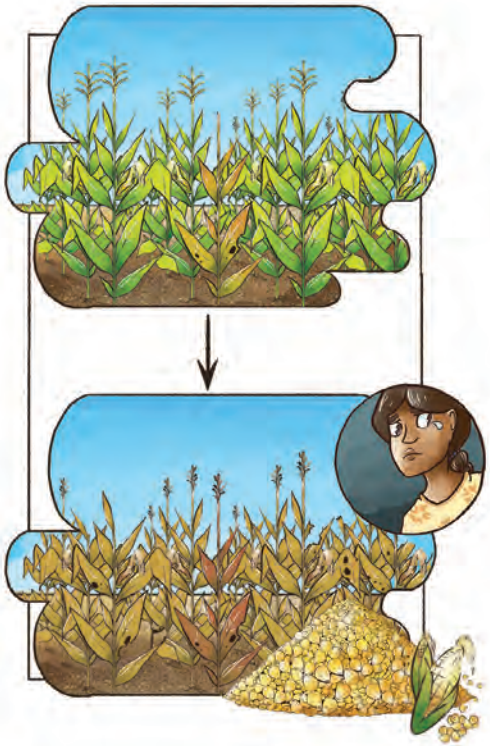
Lesson: Rotating a cereal crop (e.g. maize) with a legume crop (e.g. beans) will reduce pests and diseases and reduce need to purchase pesticides.





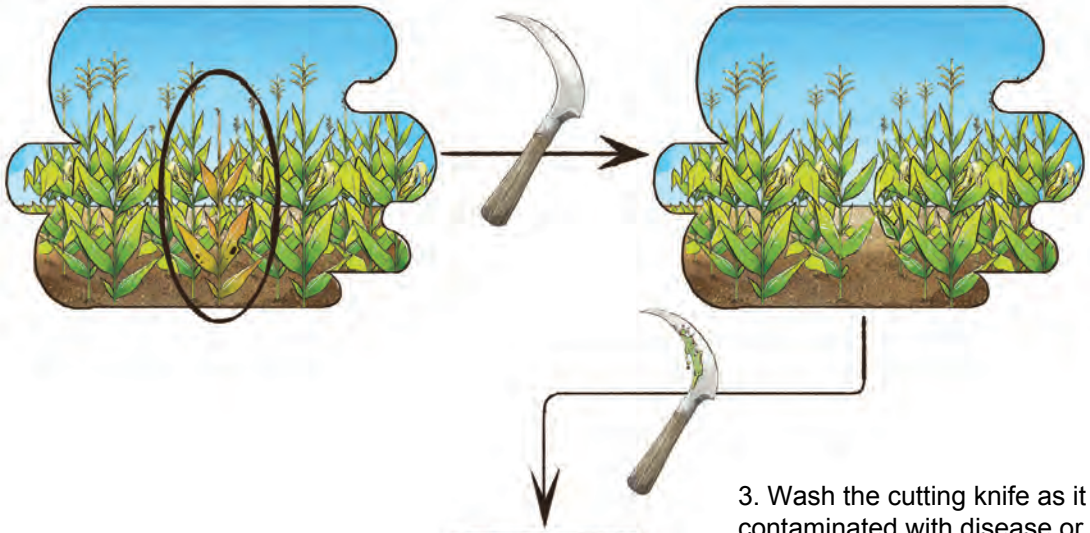


Lesson: Constantly visual inspect fields for sick plants and remove them in order to improve the health of the field



1. Traditional practice: sick plants are allowed to remain in field. Many plants become sick, low yields

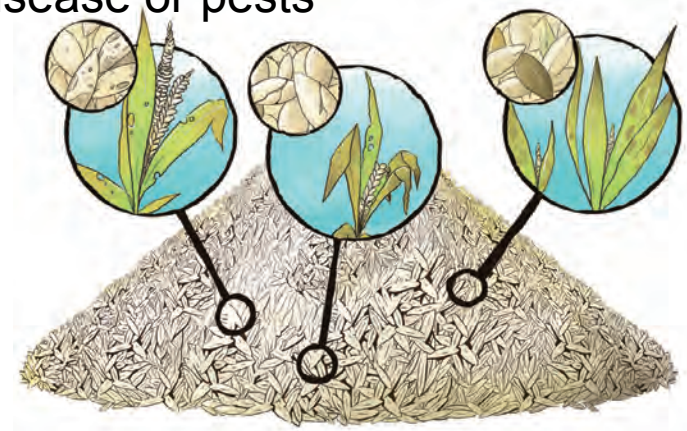
2. Improved practice: remove sick plants immediately to prevent spread of disease or pests



3. Wash the cutting knife as it may be contaminated with disease or pest

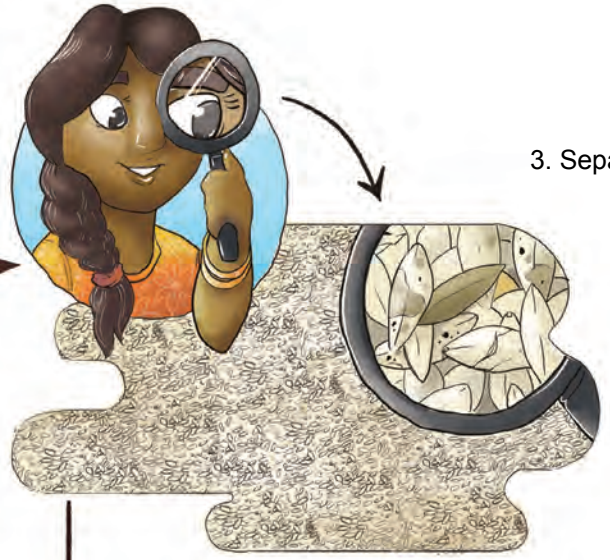
4. Field is healthy, high yields

Lesson: Before sowing seeds, use a magnifying glass/sheet to help remove seeds with disease or pests

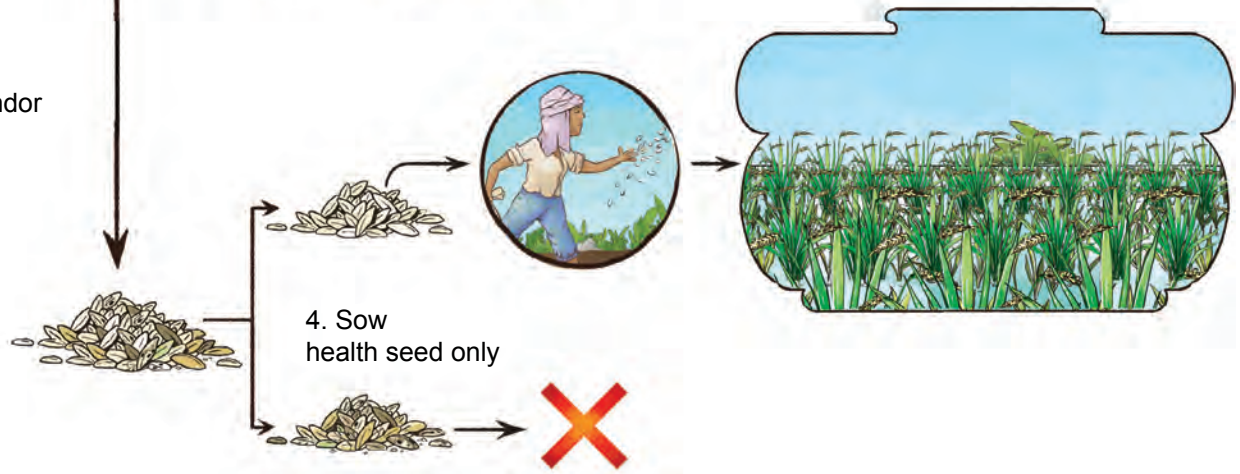


1. Seeds for sowing may have small spots or damage due to insects or mold

2. Purchase magnifying glass/sheet from vendor



3. Separate unspotted, undamaged seed

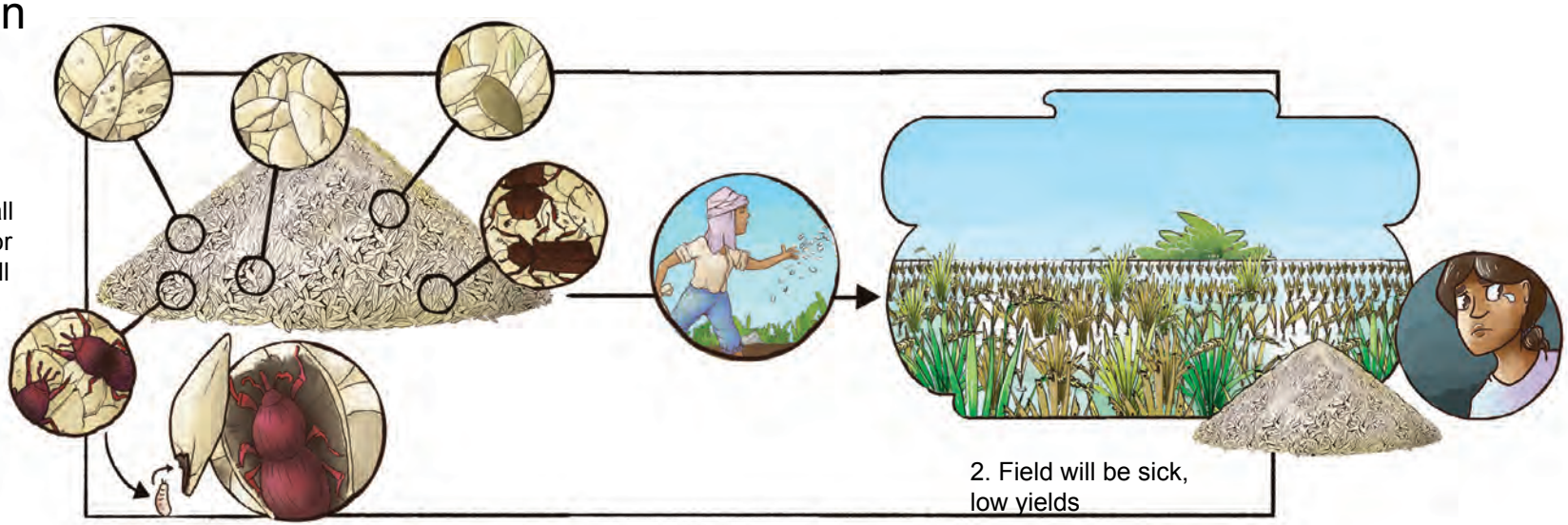


4. Sow health seed only

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

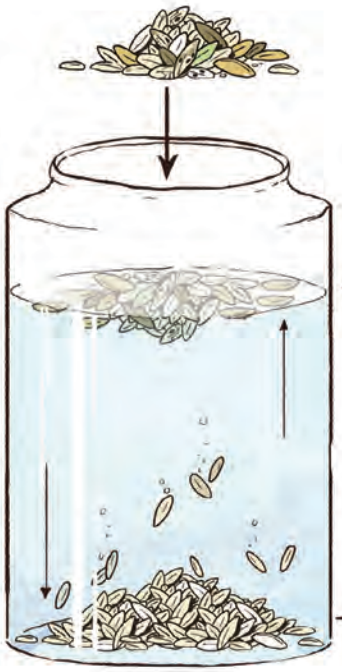
Lesson: Healthy seeds can be easily separated from sick seeds prior to sowing using water floatation

1. Traditional practice: seeds with small disease spots or containing small insects may be missed, and sown in field

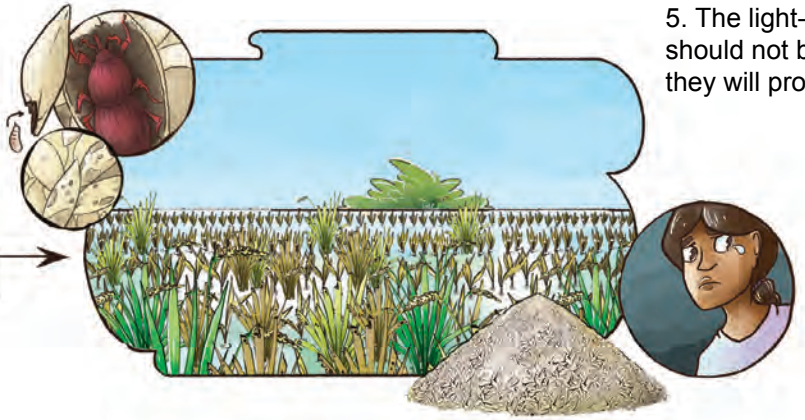


2. Field will be sick, low yields

3. Improved practice: Add seeds to water.



4. Sick seeds are light-weight and will float.



5. The light-weight seeds should not be planted as they will produce a sick field

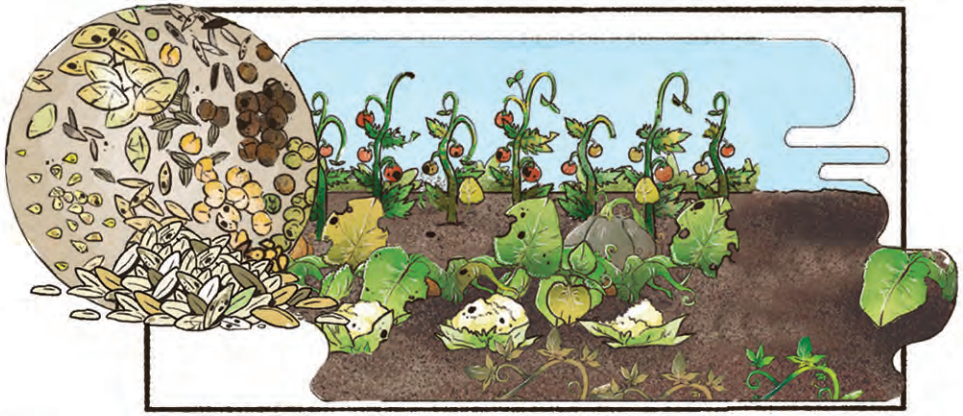
6. Healthy seeds are heavy and will sink

7. The heavy seeds will produce a healthy field

8. If seed size is large, then salt should be added to jar to better enable seed separation

Lesson: Gently heat treating vegetable seeds prior to sowing can reduce crop disease

1. Traditional practice: seeds may contain disease leading to field diseases



2. Improved practice: Purchase a thermometer from a vendor, then add water pre-heated to 45˚C to seeds

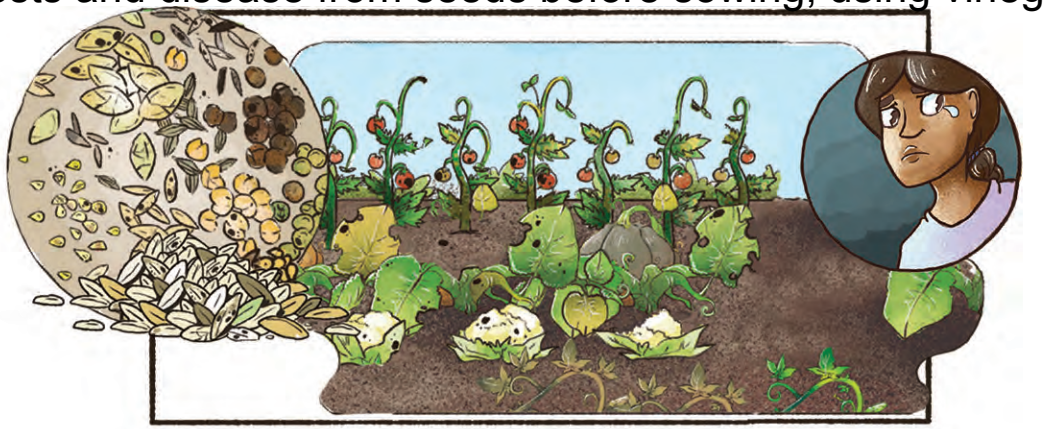
3. Incubate for 1 hour. Heat will kill some diseases

4. Vegetable garden may be healthier but if the water temperature is too high, then seeds will be damaged

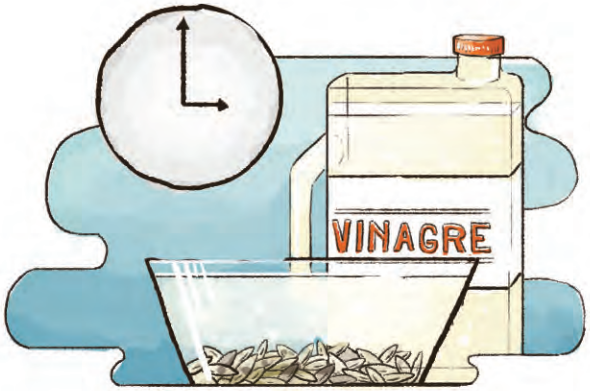
5. Be careful: excess temperature or time will kill seeds.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using vinegar.

1. Problem: vegetables damaged by pests and disease



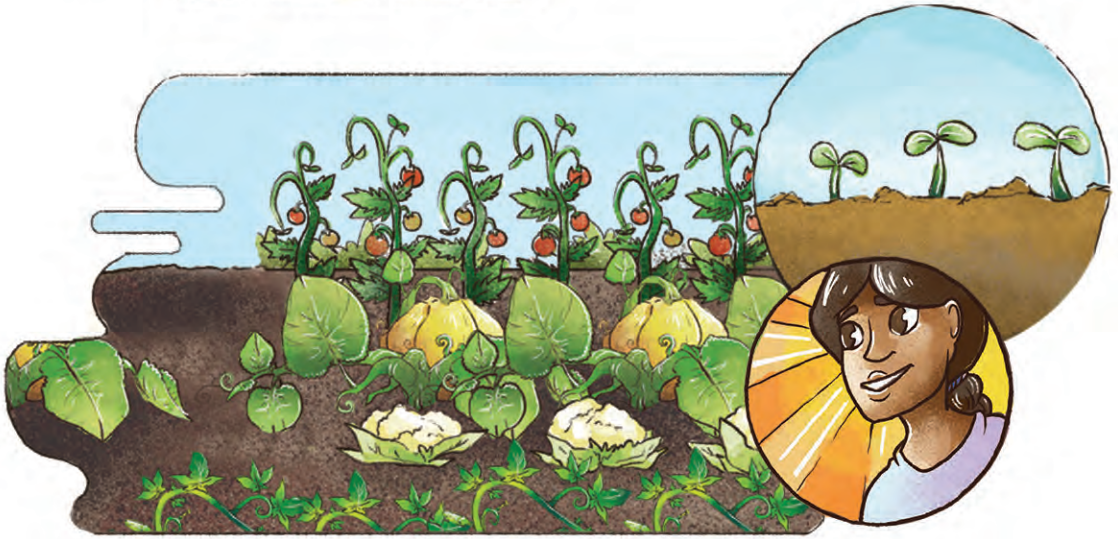
2. Partial solution: soak seeds for a few minutes in vinegar



3. Rinse with water

4. Sow seeds

5. Healthier plants

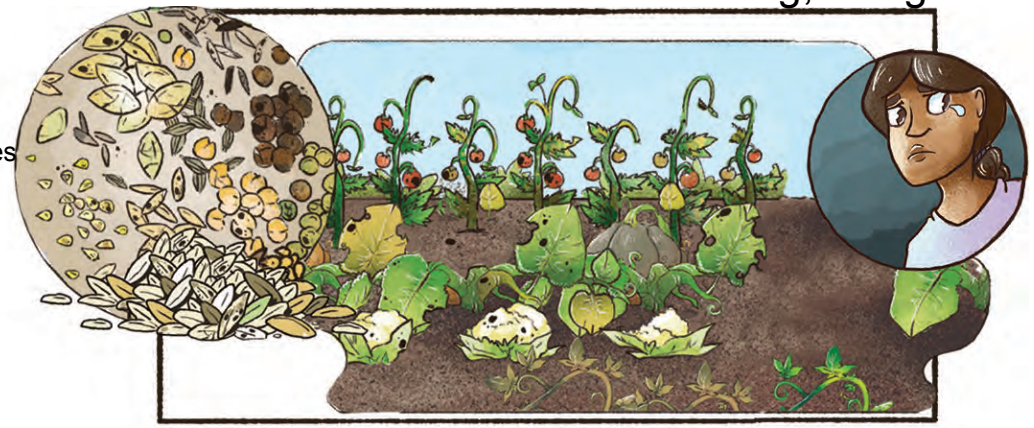


6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

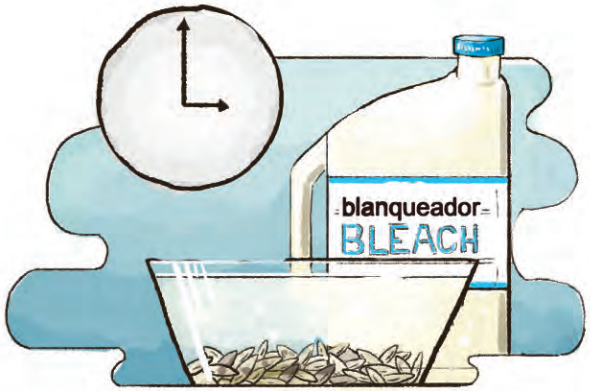
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

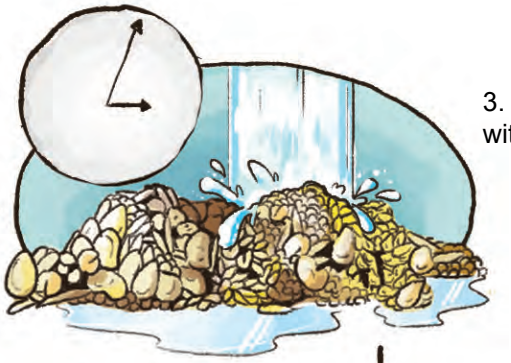
Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using diluted bleach.

1. Problem: vegetables damaged by pests and disease



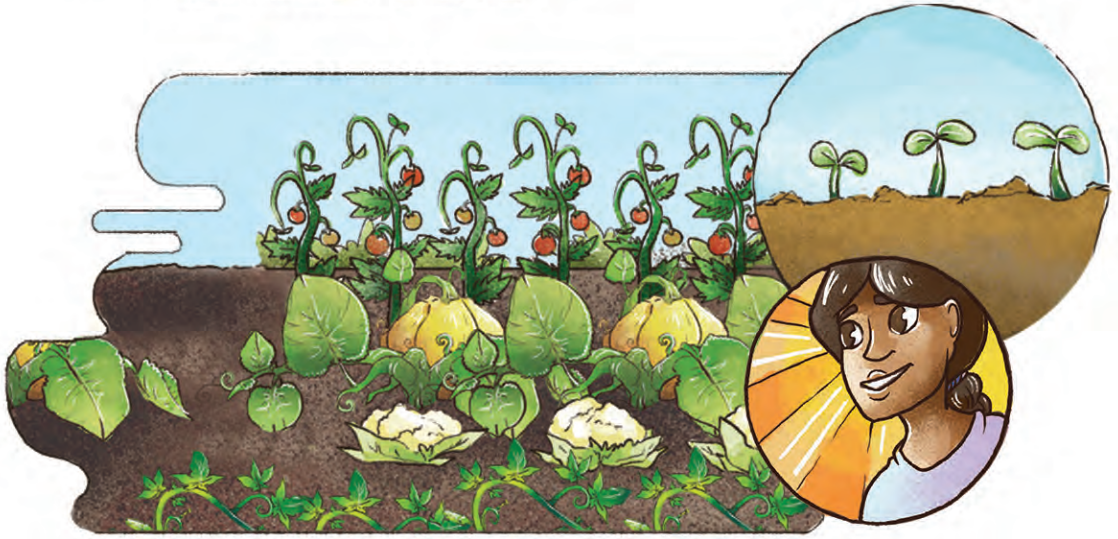
2. Partial solution: soak seeds for a few minutes in diluted bleach





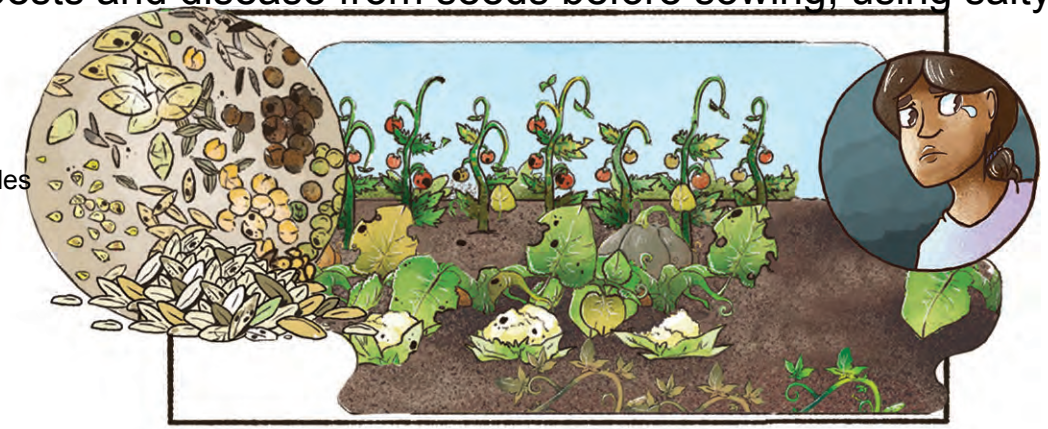
3. Rinse with water

4. Sow seeds

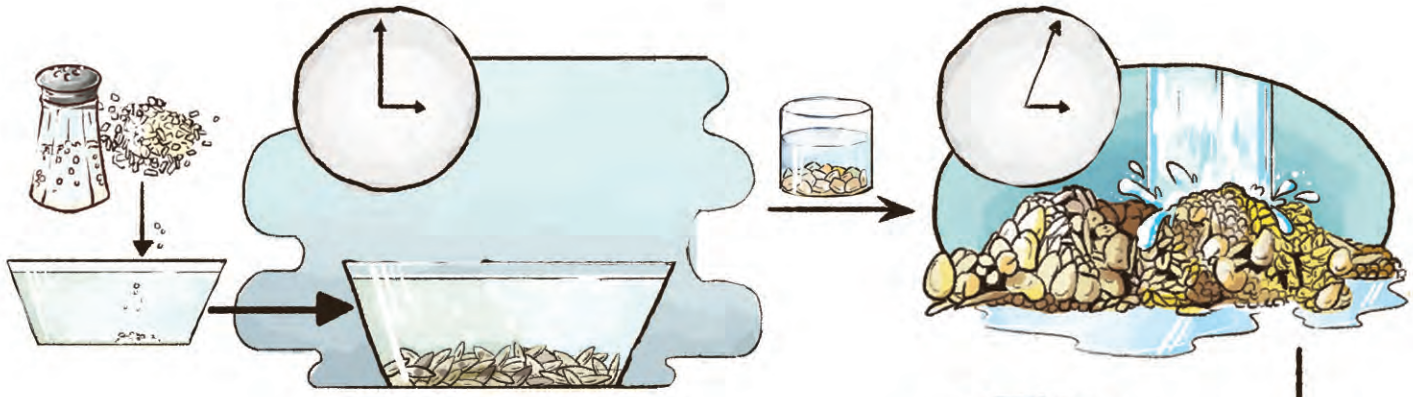


6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using salty water.



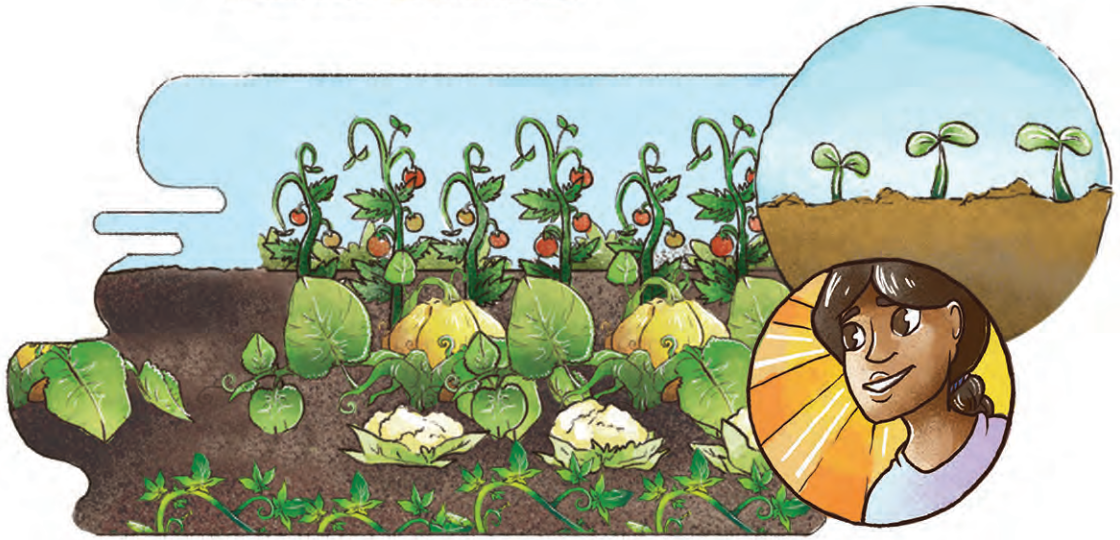
1. Problem: vegetables damaged by pests and disease



2. Partial solution: soak seeds for a few minutes in very salty water

3. Rinse with non-salty water

4. Sow seeds



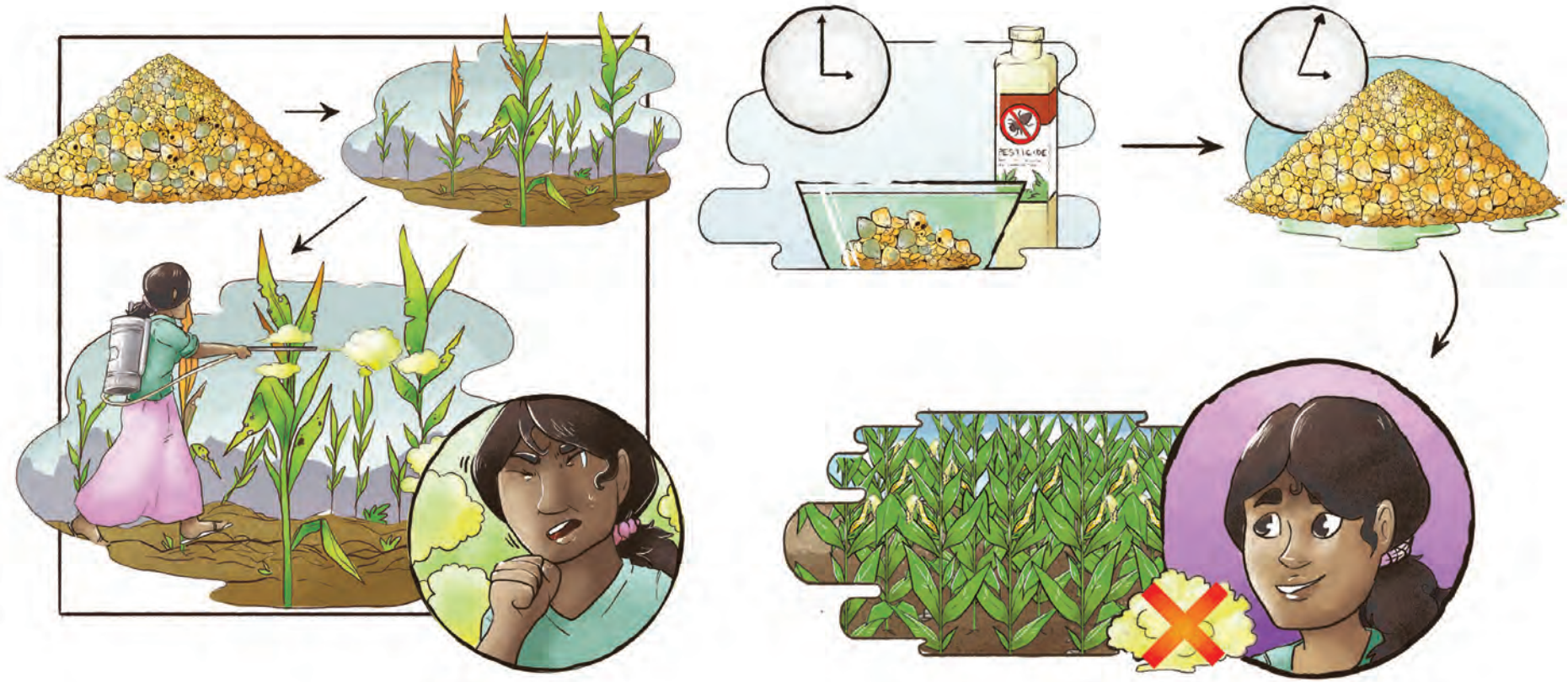
5. Healthier plants

6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to coat seeds with these chemicals before sowing

1. Traditional practice

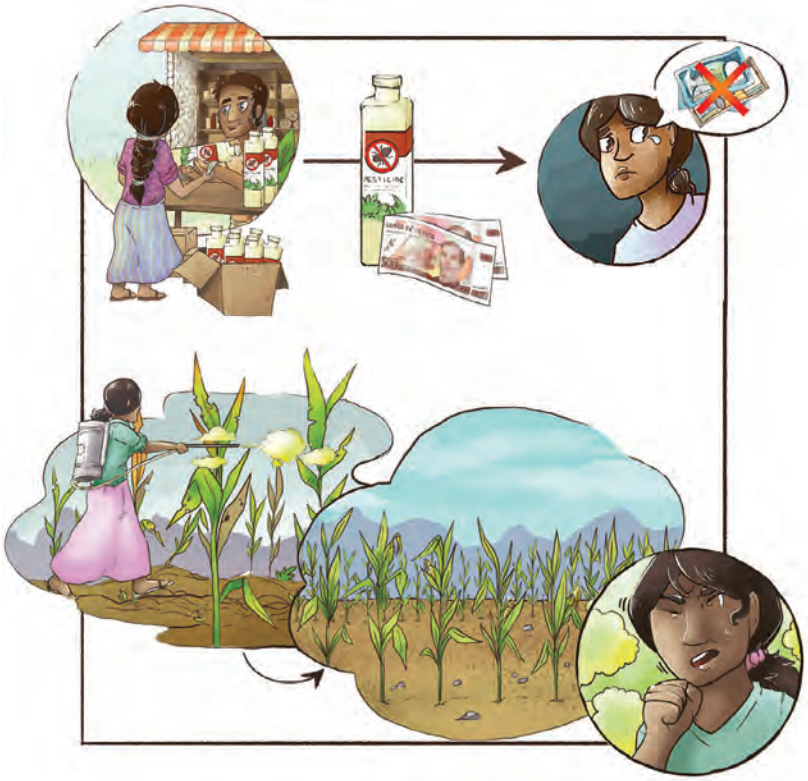
2. Improved practice: soak seeds in pesticide prior to sowing



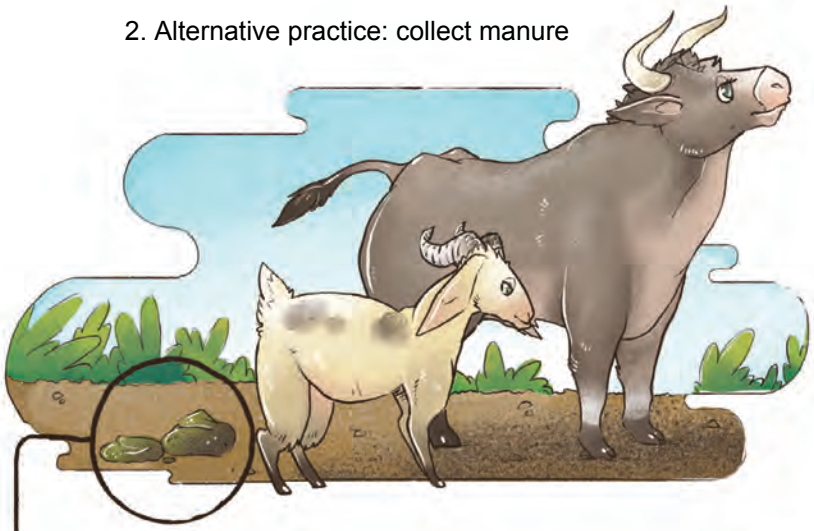
3. Less spraying in the field

Lesson: Manure that is soaked in water can be sprayed onto crops to fight crop disease

1. Traditional practice: purchase pesticides and spray onto field

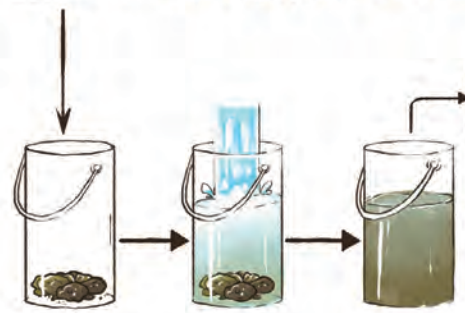


2. Alternative practice: collect manure



3. Dry manure in sun for many days to kill harmful microbes

4. Add manure to water



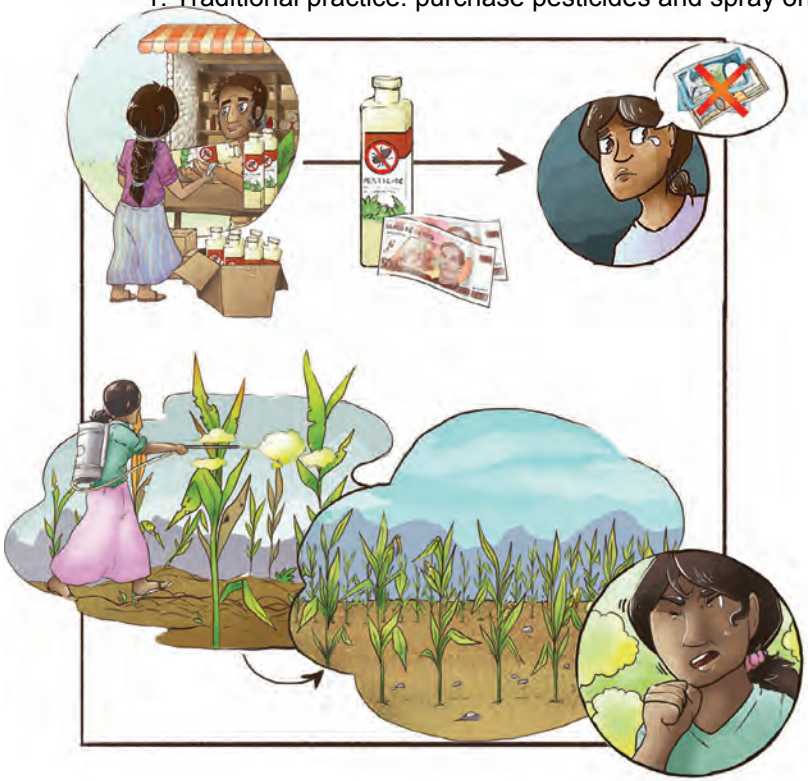
5. Spray manure liquid onto field. Healthy microbes in manure will fight microbes that damage crops.

6. Less need to purchase pesticides.

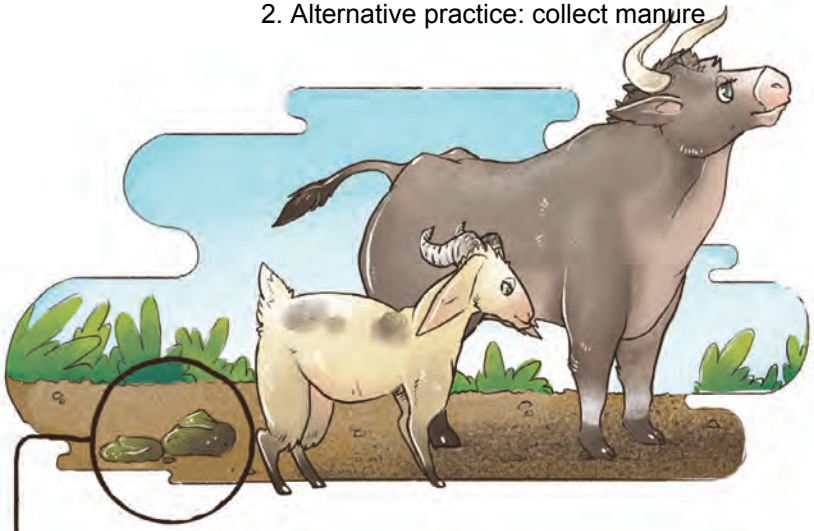
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: Manure soaked in water can be added to seeds before sowing to fight crop disease

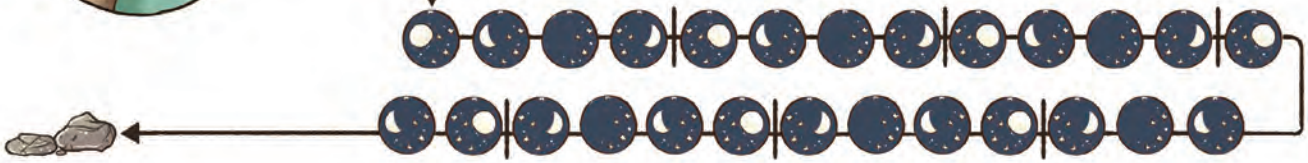
1. Traditional practice: purchase pesticides and spray onto field



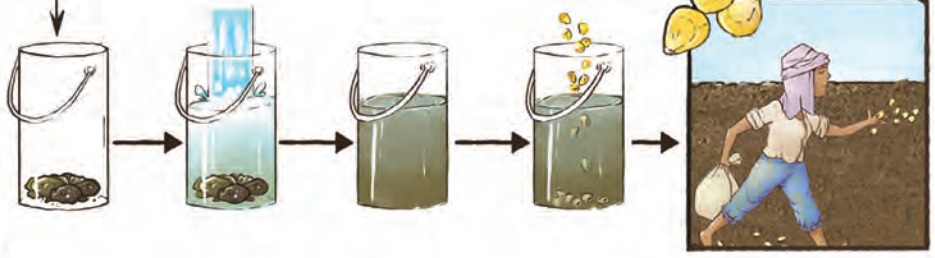
2. Alternative practice: collect manure



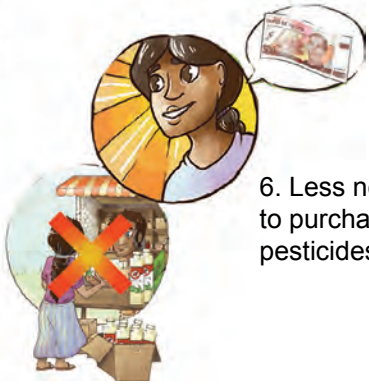
3. Dry manure in sun for many days to kill harmful microbes



4. Add manure to water

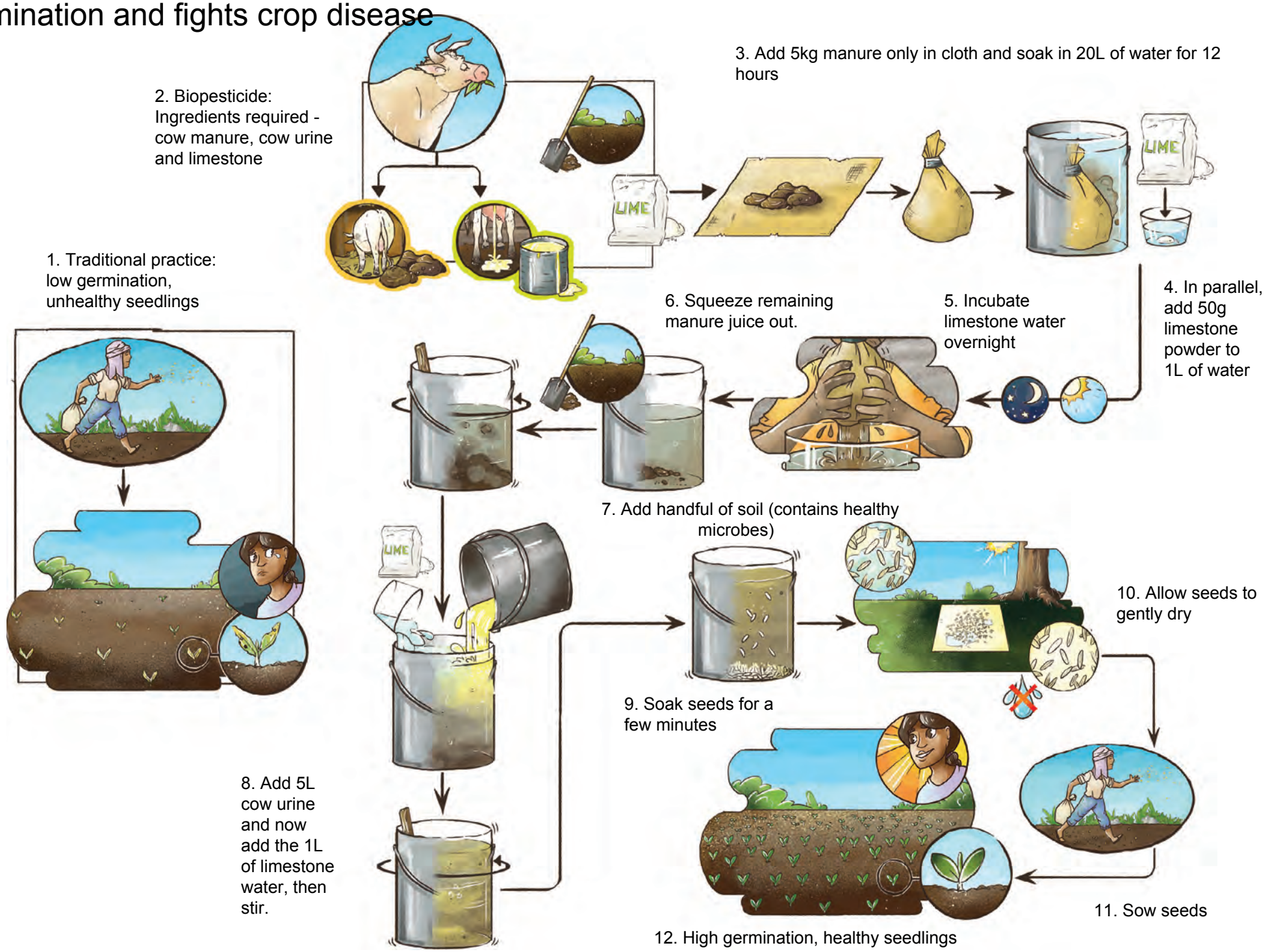


5. Soak seeds in the diluted manure. Healthy microbes in manure will fight microbes that damage crops.



6. Less need to purchase pesticides.

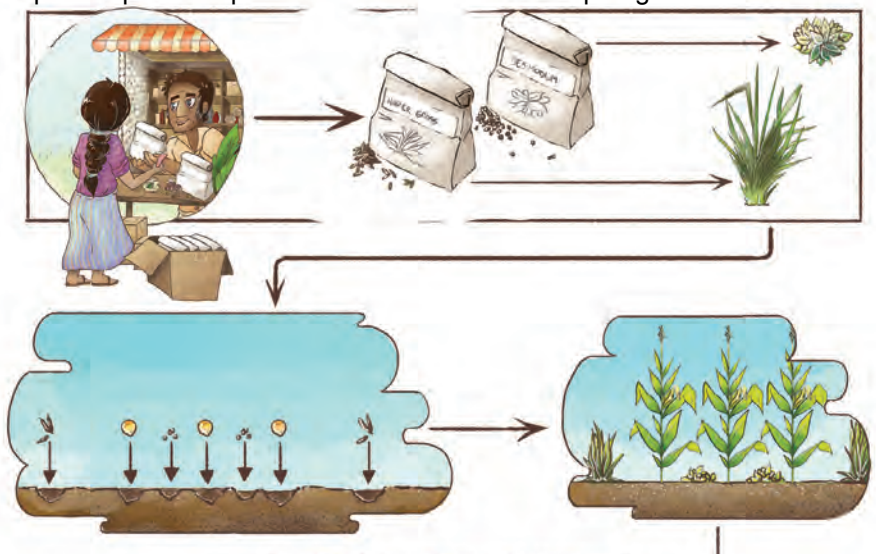
Lesson: An indigenous bio-pesticide (Bijamrita) added to seeds before sowing improves germination and fights crop disease



Lesson: Intercropping with Desmodium cover crop and Napier grass as a border crop reduces flying insects

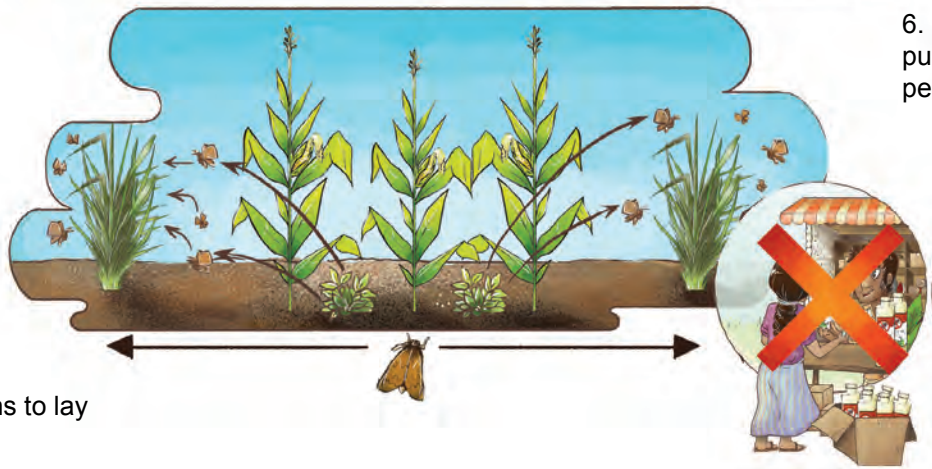
1. Traditional practice: expensive pesticides are purchased from vendor and sprayed

2. Improved practice: purchase Desmodium and Napier grass seed from vendor



3. Intercrop with Desmodium

4. Border row of Napier grass



5. Desmodium produces a gas scent that pushes insect moths away from field. Napier grass produces a gas scent that attracts moths to lay their eggs and hence pulls them out of field.

6. Less need to purchase pesticides

7. Desmodium also enriches soil. Desmodium and Napier are also livestock feeds.

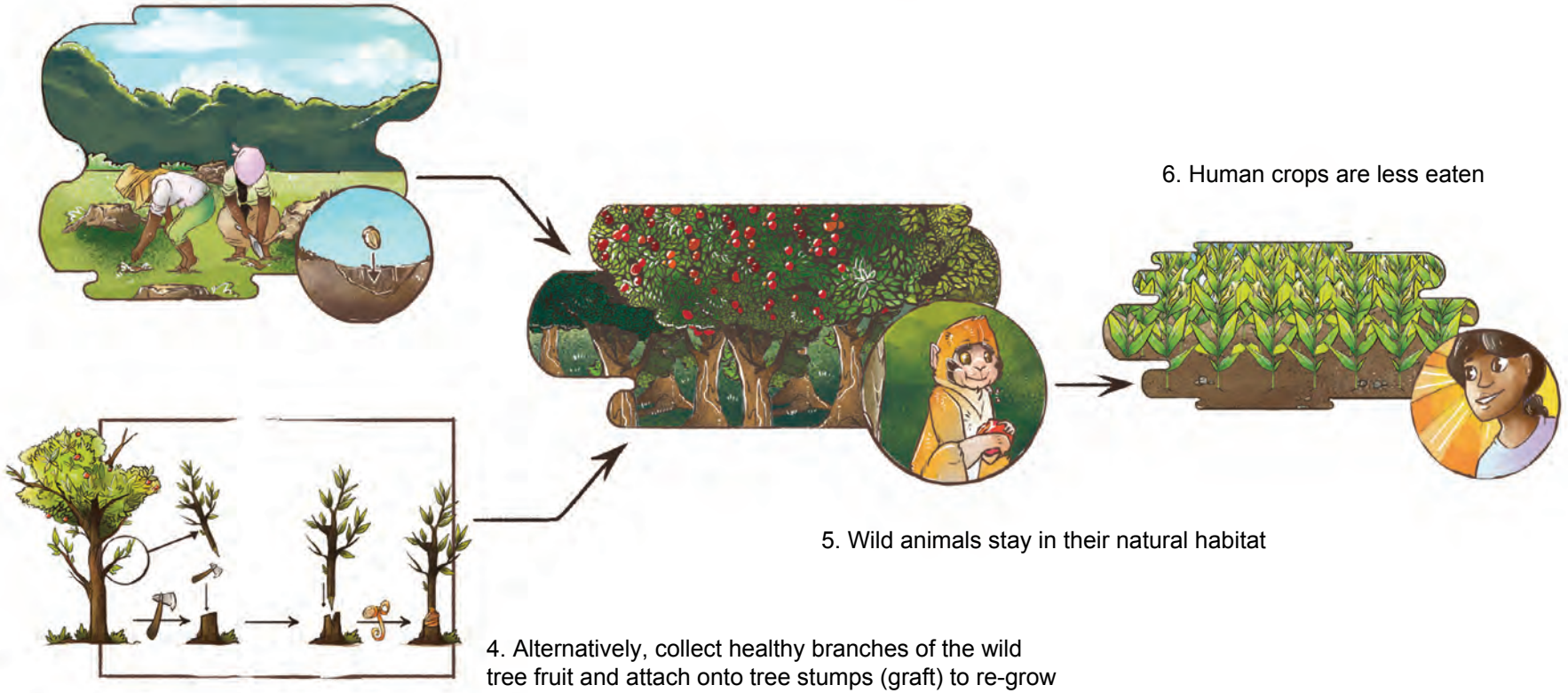
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Replenishing the natural foods of wild animals may prevent them from attacking human crops

1. Traditional practice: animals such as monkeys eat wild foods in the forest but the wild food is less available

2. Animals eat human crops in field

3. Improved practice: Collect seeds to grow the tree fruits of the wild animals



6. Human crops are less eaten

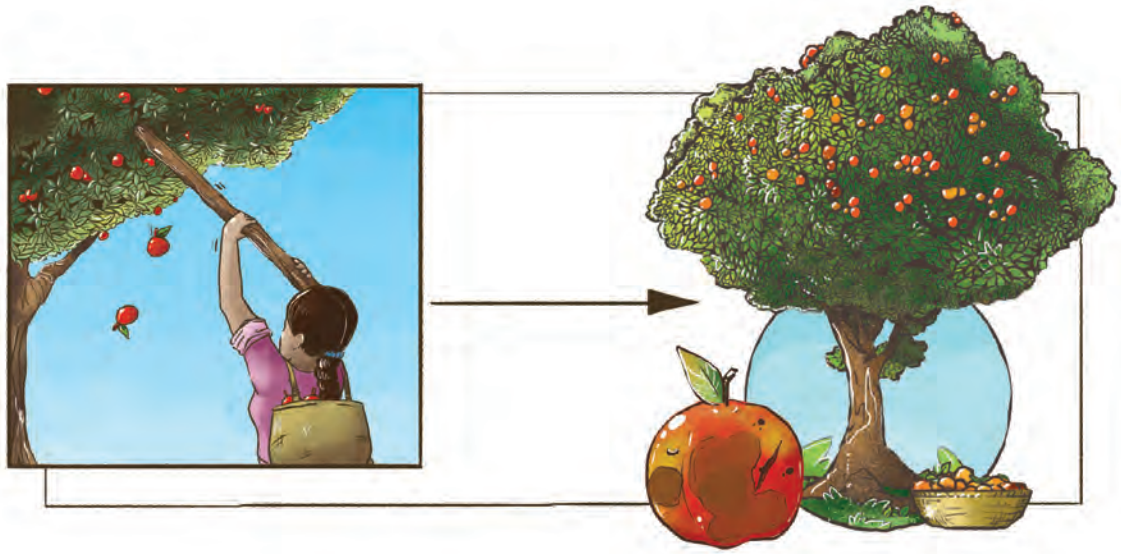
5. Wild animals stay in their natural habitat

4. Alternatively, collect healthy branches of the wild tree fruit and attach onto tree stumps (graft) to re-grow trees faster

Chapter 9: **Post-Harvest**

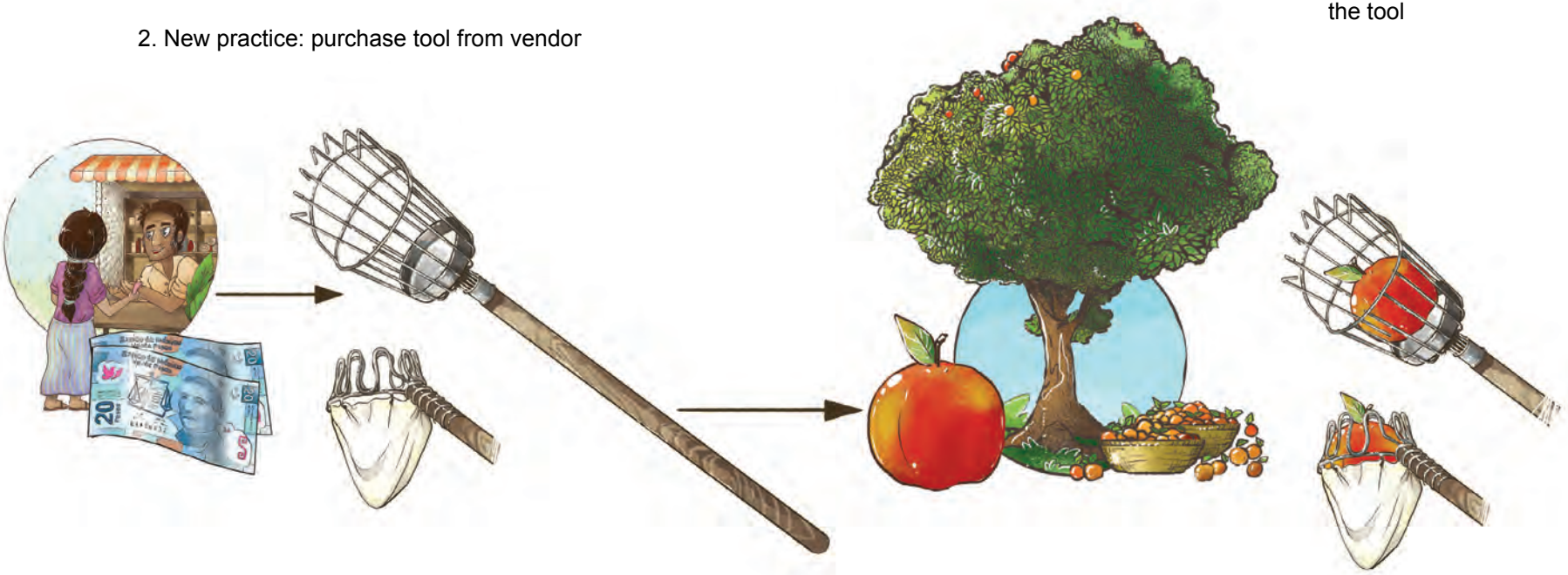
Lesson: New tool to harvest tree fruits without climbing trees

1. Traditional practice



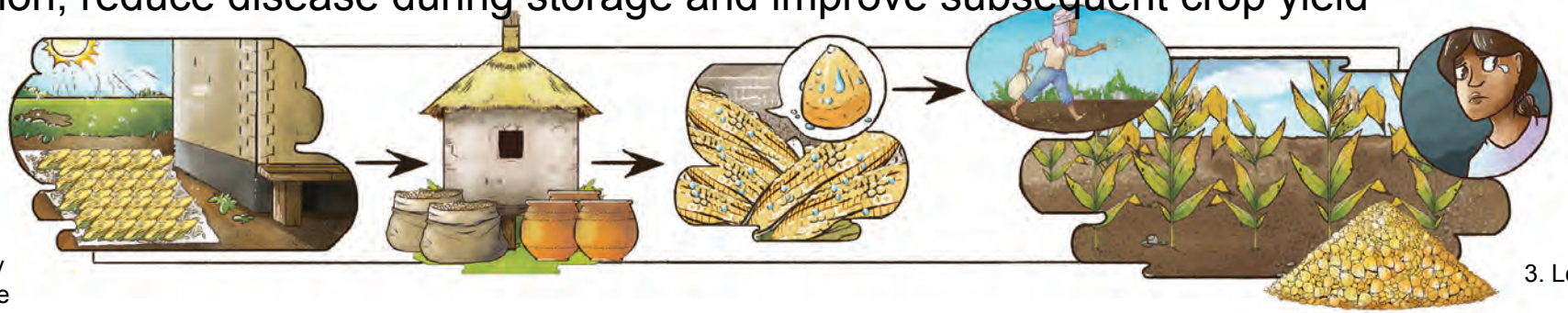
2. New practice: purchase tool from vendor

3. Pick fruit using the tool



Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: Drying seeds prior to storage above the cooking fire will improve subsequent germination, reduce disease during storage and improve subsequent crop yield

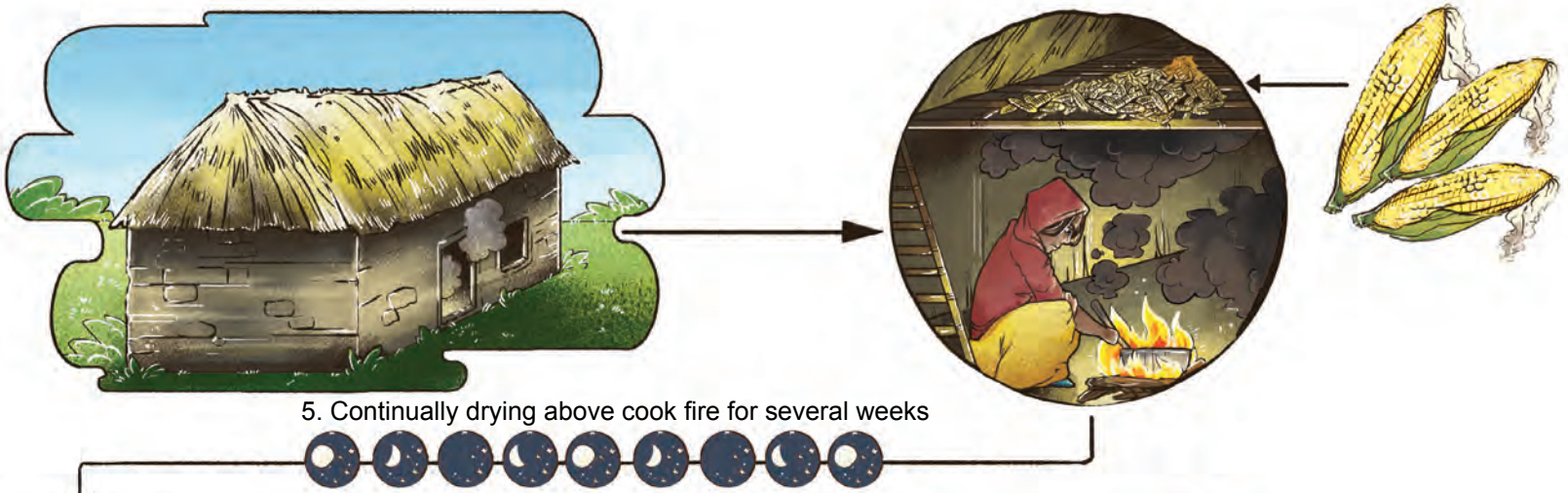


1. Traditional practice is to sun dry only prior to storage

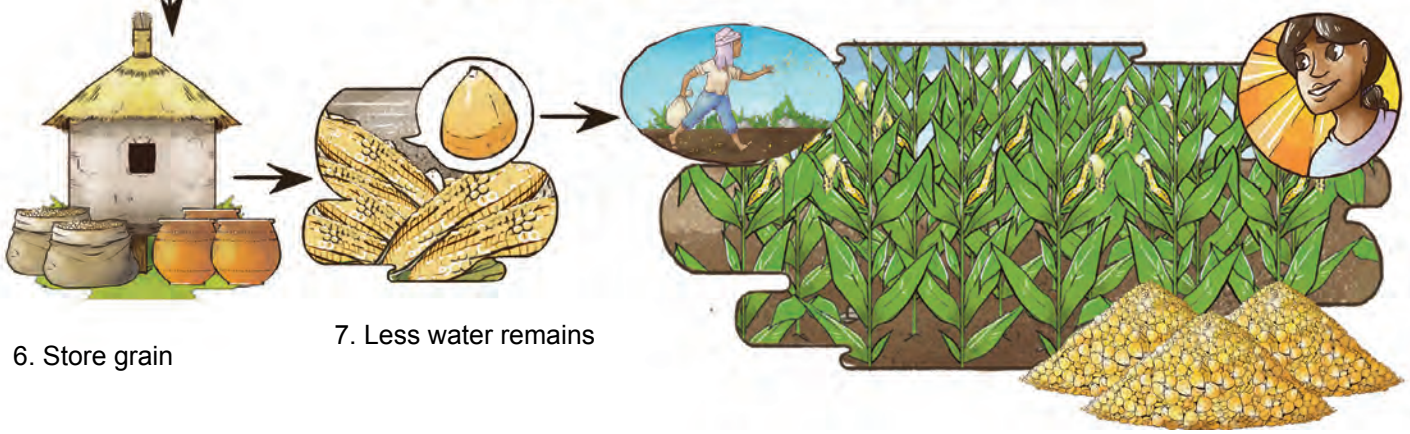
2. Some moisture remains which promotes molds and insects

3. Low yield

4. Improved practice is to additionally dry seeds above cooking fire



5. Continually drying above cook fire for several weeks

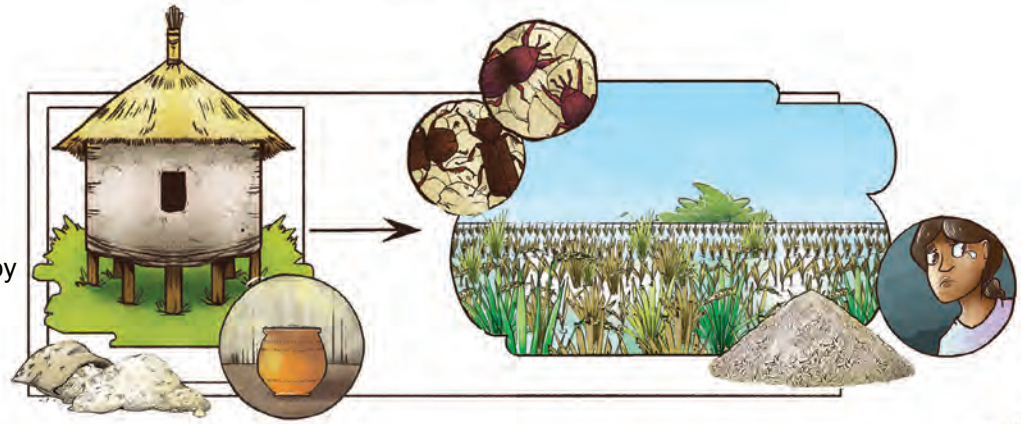


6. Store grain

7. Less water remains

8. Improved germination, healthier plants and higher yield

Lesson: Neem tree leaves fight pests during grain storage

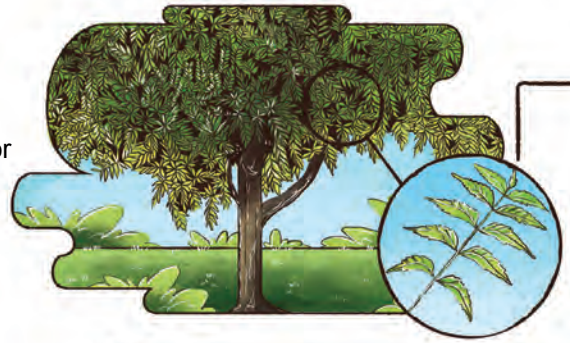


1. Traditional problem: stored grain is damaged by insects during storage.

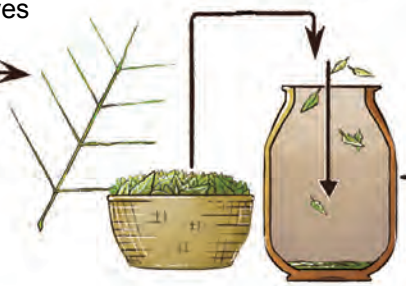
2. When sown, the damaged seeds produce low yields

3. Improved practice

4. Grow or find neem trees



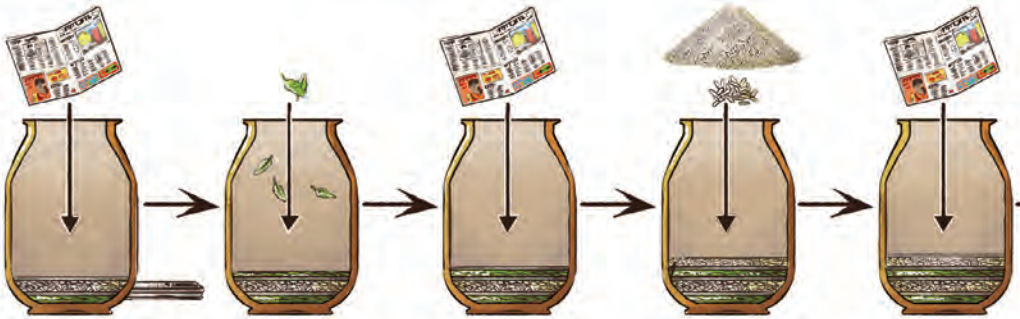
5. Collect neem leaves



6. Add leaves to granary as a layer

7. Add newspaper layer

8. Add grain layer



9. Repeat newspaper

10. Repeat neem leaves

11. Repeat newspaper

12. Repeat grain

13. Repeat newspaper

14. Repeat layering until granary is full

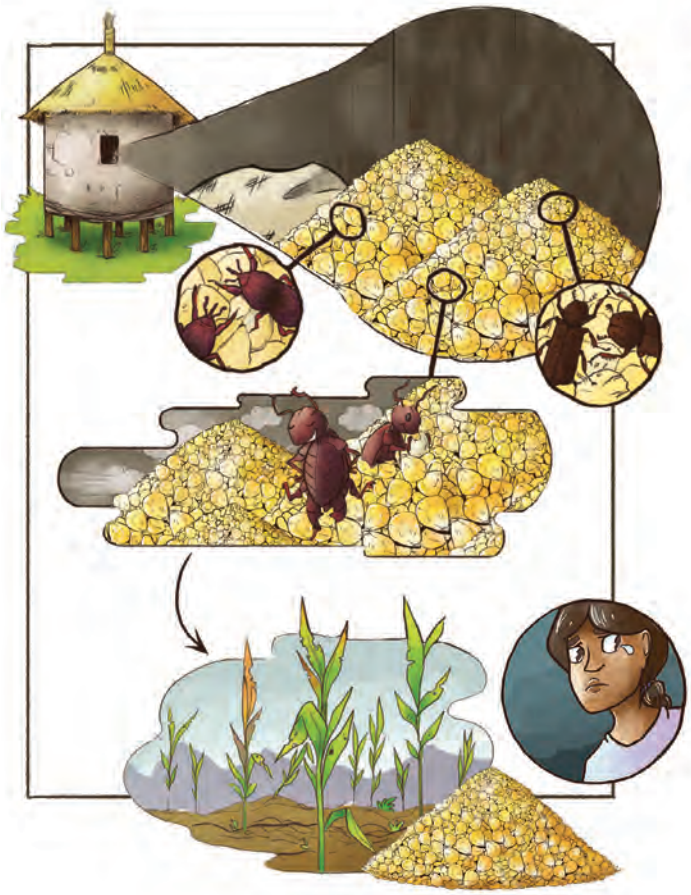
15. Store grain

16. Less insect damage

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

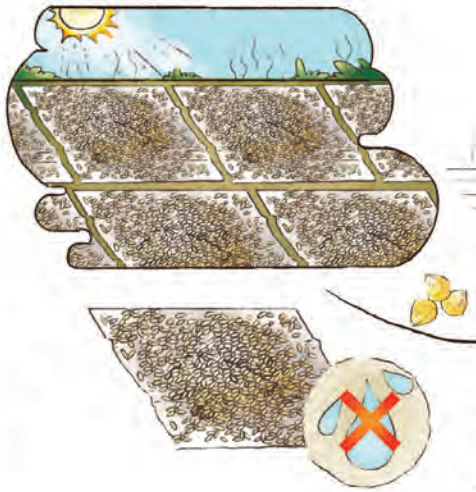
Lesson: Special bags can be used to store grain which reduce oxygen inside bag which prevents insects and fungal molds from surviving, which also reduces toxins.

1. Traditional practice: stored grain is damaged by insects and mold. The mold can produce toxins in the grain.

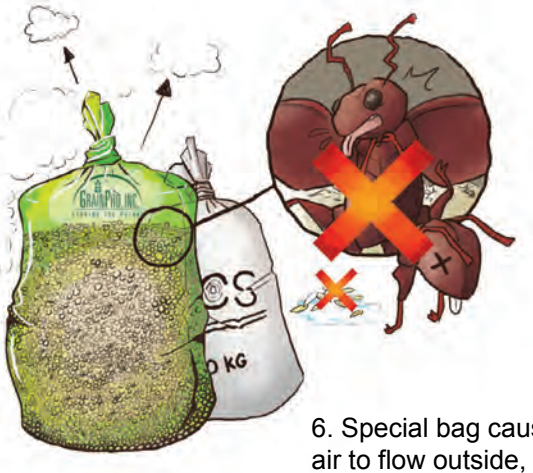


2. New practice

3. Dry grain completely

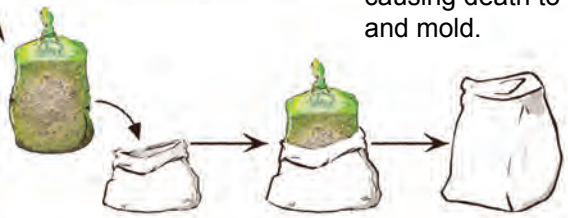


4. Purchase bag from vendor. Put grain in bag, remove air and tie.



5. Put bag inside a jute bag. Elevate from ground if possible to prevent rodents.

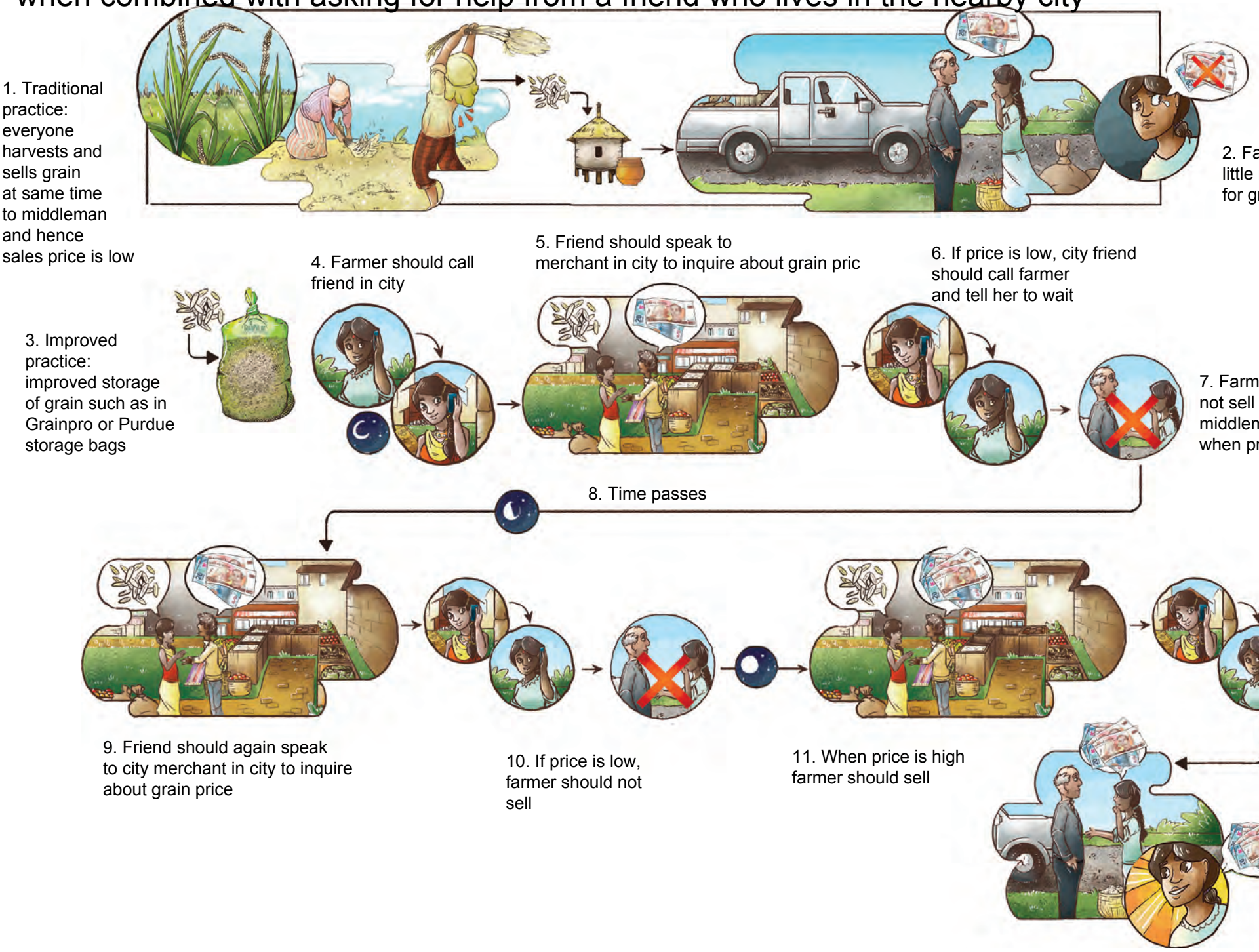
6. Special bag causes air to flow outside, causing death to insects and mold.



7. High yield if sown and less toxins in food.

8. Re-use bag many times.

Lesson: Improved storage of grain permits selling of grain when prices are higher, especially when combined with asking for help from a friend who lives in the nearby city



Lesson: Special small green bags may prevent fruits and vegetables from spoiling/ripening too fast

1. Traditionally, fruits/vegetables spoil quickly: when one fruit/vegetable starts to ripen, it releases a gas which causes nearby fruits/vegetables to ripen

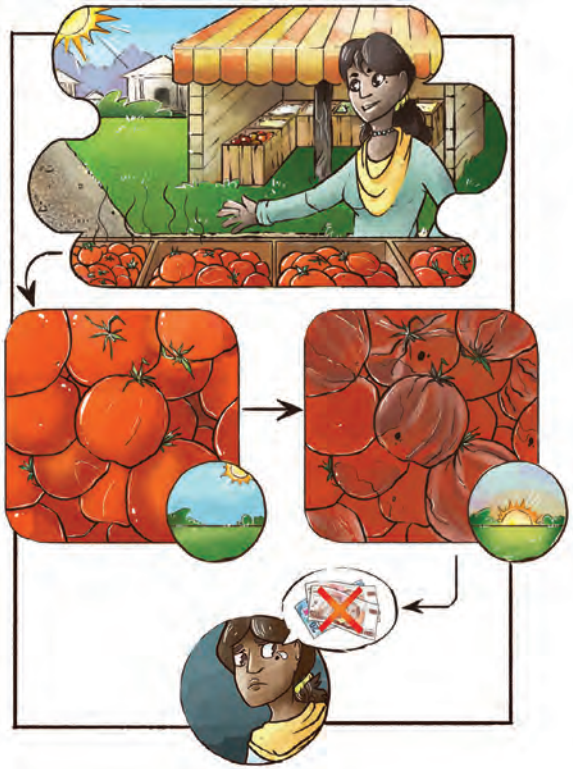
2. New practice: purchase an anti-ripening bag from vendor. The bag stops the gas that promotes ripening, preserving the fruits/vegetables for a few more days.

3. Bags are dirty after use

4. Wash in water

5. Re-use many times

Lesson:To prevent spoilage of fruits and vegetables, a simple clay cooler may be built.



1. Problem: Farmer tries to sell vegetables such as tomatoes in the market but they spoil quickly, causing loss of income

2. Improved practice

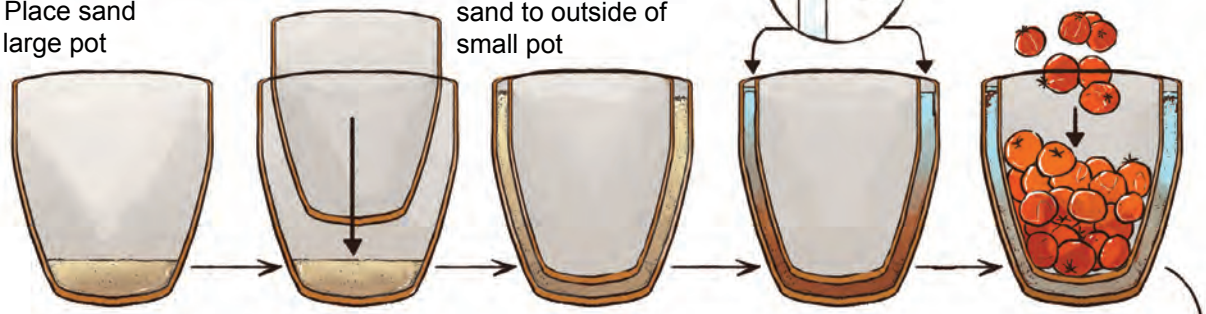
3. Materials needed:
1 large clay pot, 1 smaller clay pot, sand, water and a cloth

4. Place sand in large pot

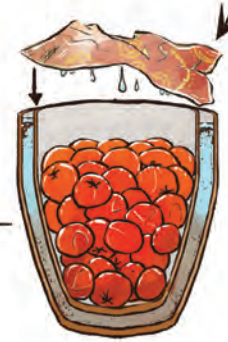
5. Insert small pot in large pot and add sand to outside of small pot

6. Add water to sand

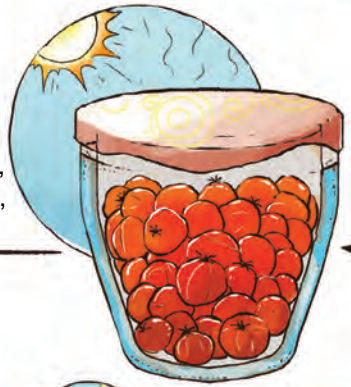
7. Add fruits/ vegetables into small pot



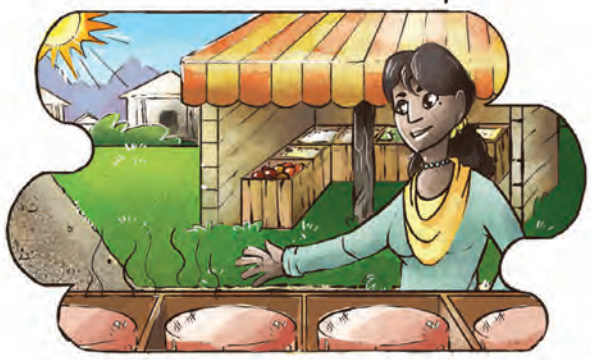
8. Cover with wet cloth

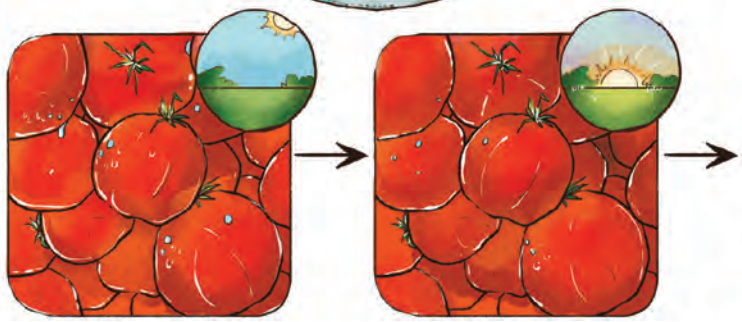


9. When exposed to heat, water in sand evaporates, which will cool inner pot



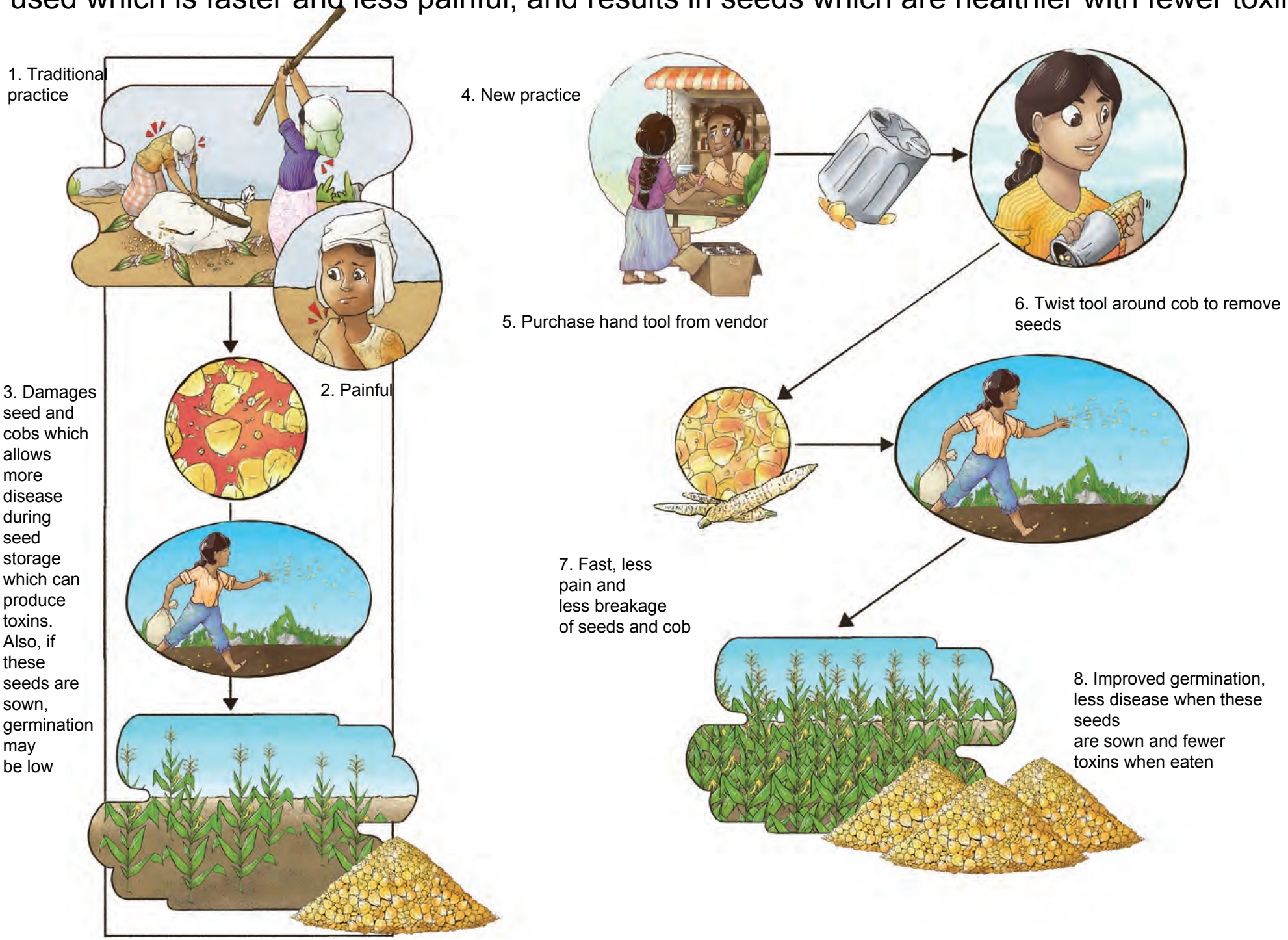
10. Less spoilage



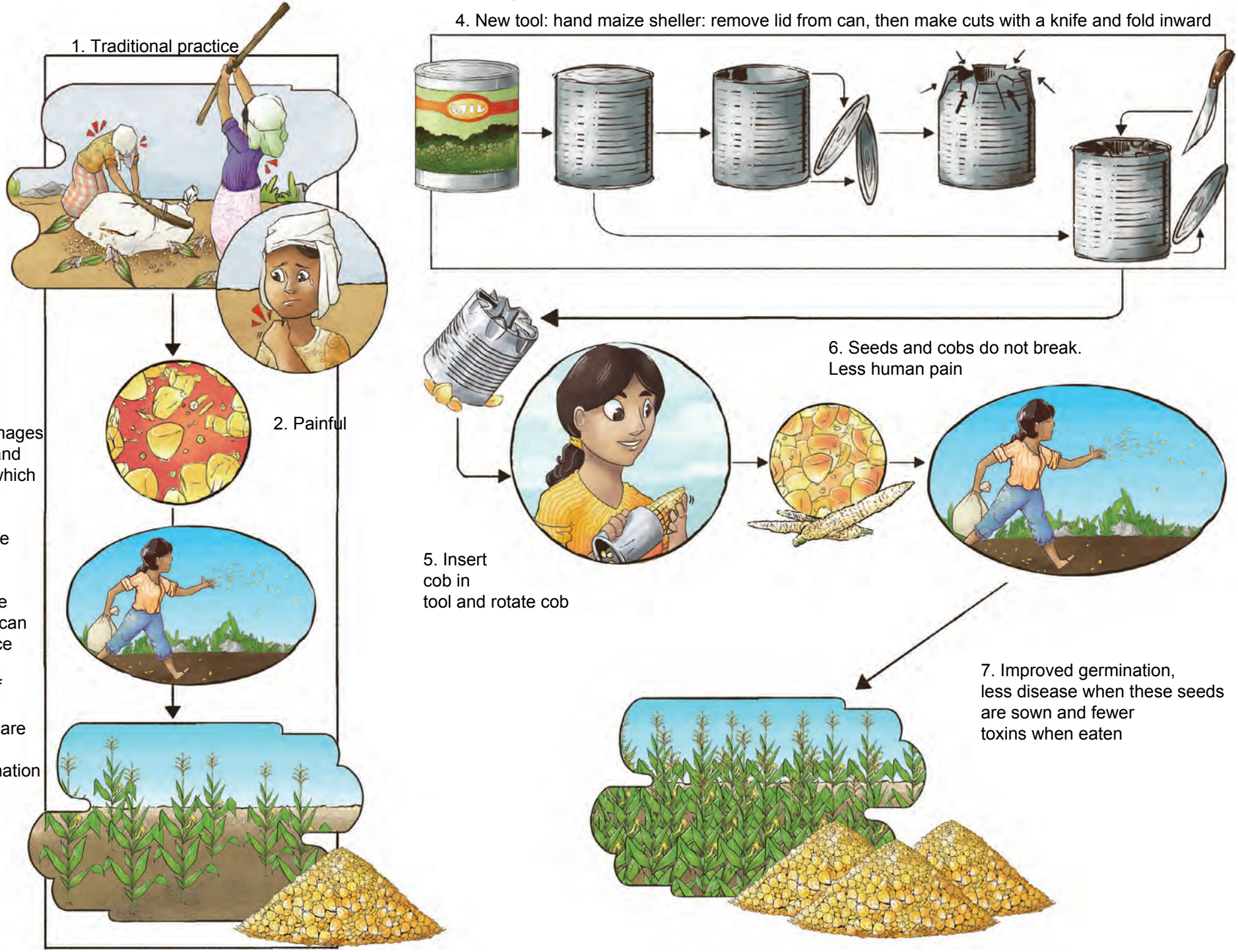


11. Higher income

Lesson: Instead of removing grains of maize by beating sacks with a stick, a hand tool can be used which is faster and less painful, and results in seeds which are healthier with fewer toxins



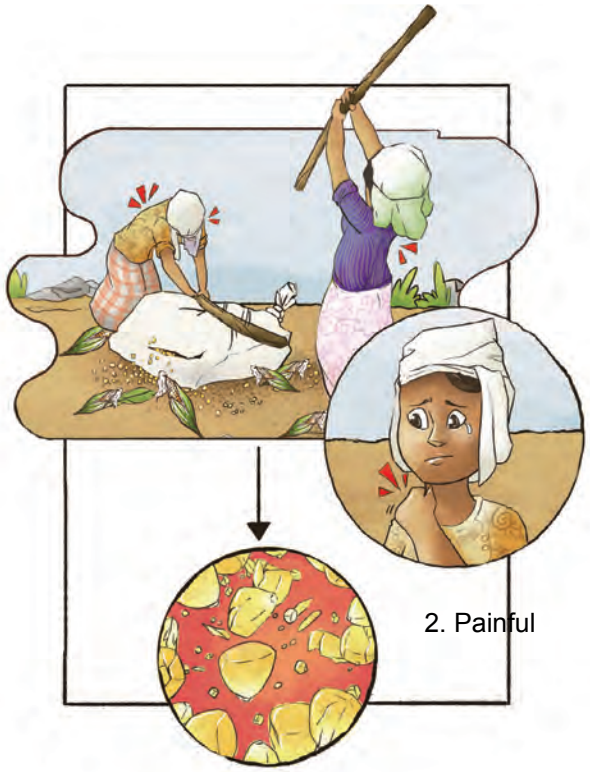
Lesson: Instead of removing grains of maize by beating sacks with a stick, a hand tool can be made from a tin can which is faster and less painful and results in less toxin in the grain.



Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

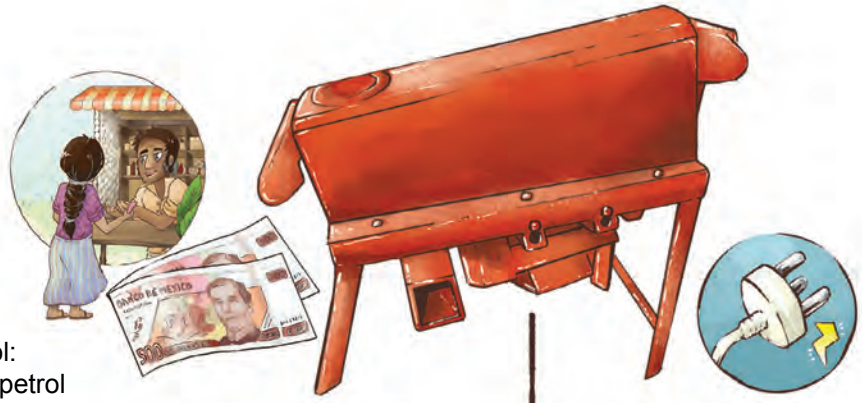
Lesson: New tools from vendor to remove maize seeds from cob

1. Traditional practice



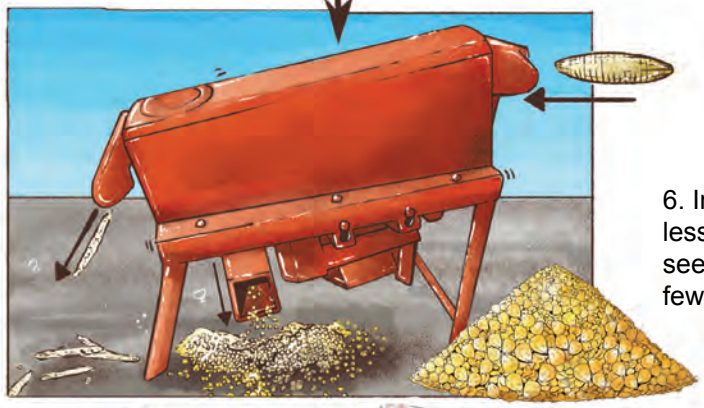
2. Painful

3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low



4. New tool: electric or petrol maize sheller from vendor

5. Simply insert cobs into machine

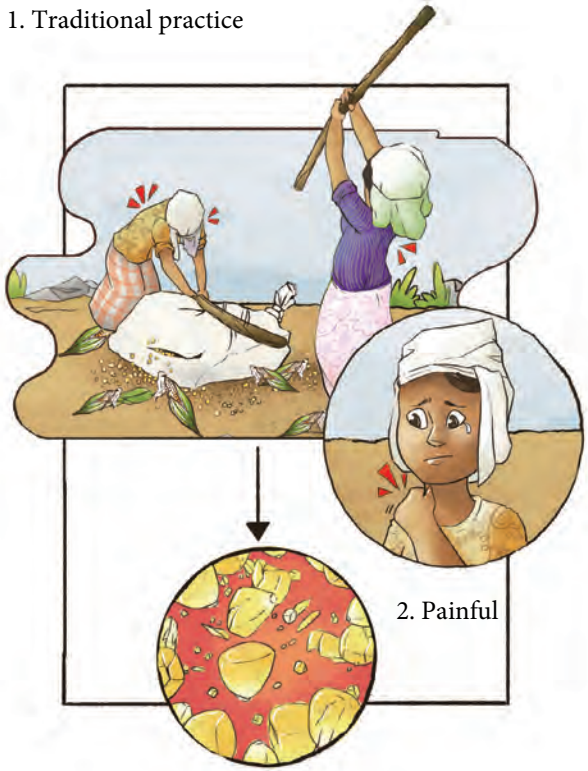


6. Improved germination, less disease when these seeds are sown and fewer toxins when eaten

7. Owner can rent machine or offer service for a fee as a small business opportunity

Lesson: New tools from vendor to remove maize seeds from cob

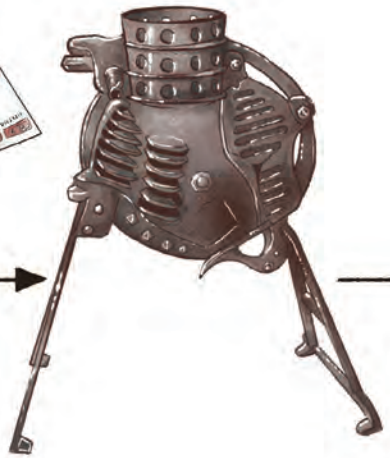
1. Traditional practice



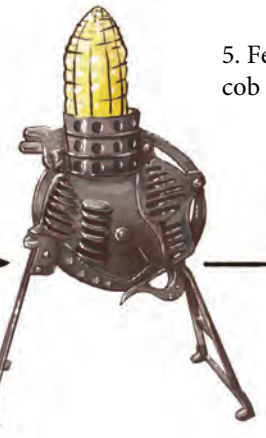
2. Painful

3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low

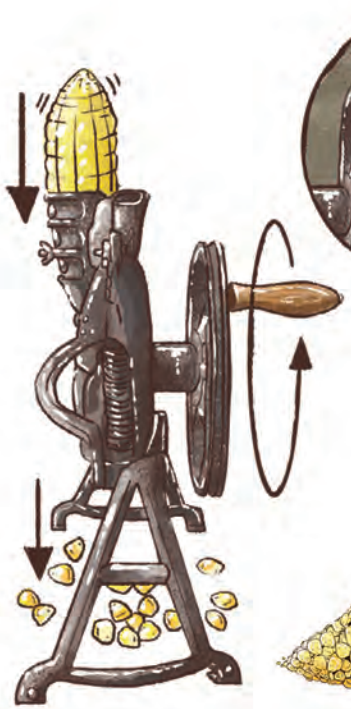
4. New tool: Hand operated maize sheller



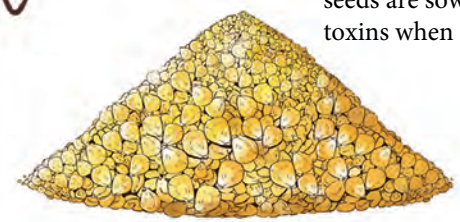
5. Feed each cob into machine



6. Turn cranl



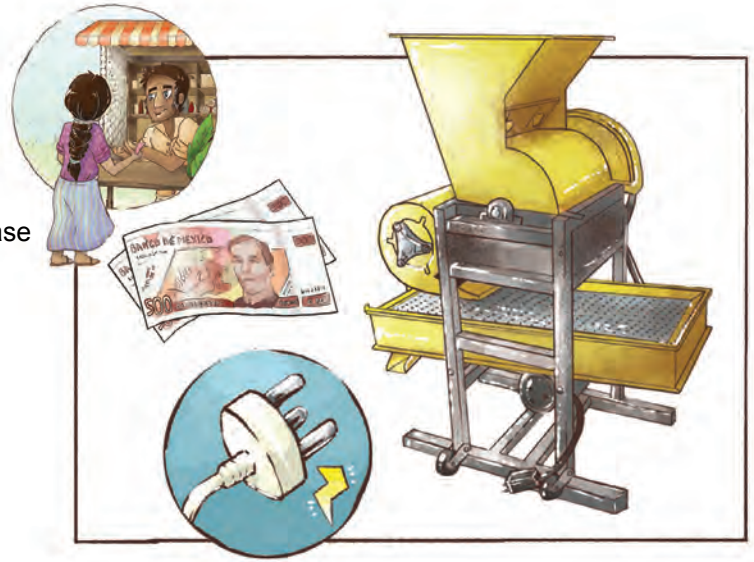
7. Improved germination, less disease when these seeds are sown and fewer toxins when eaten

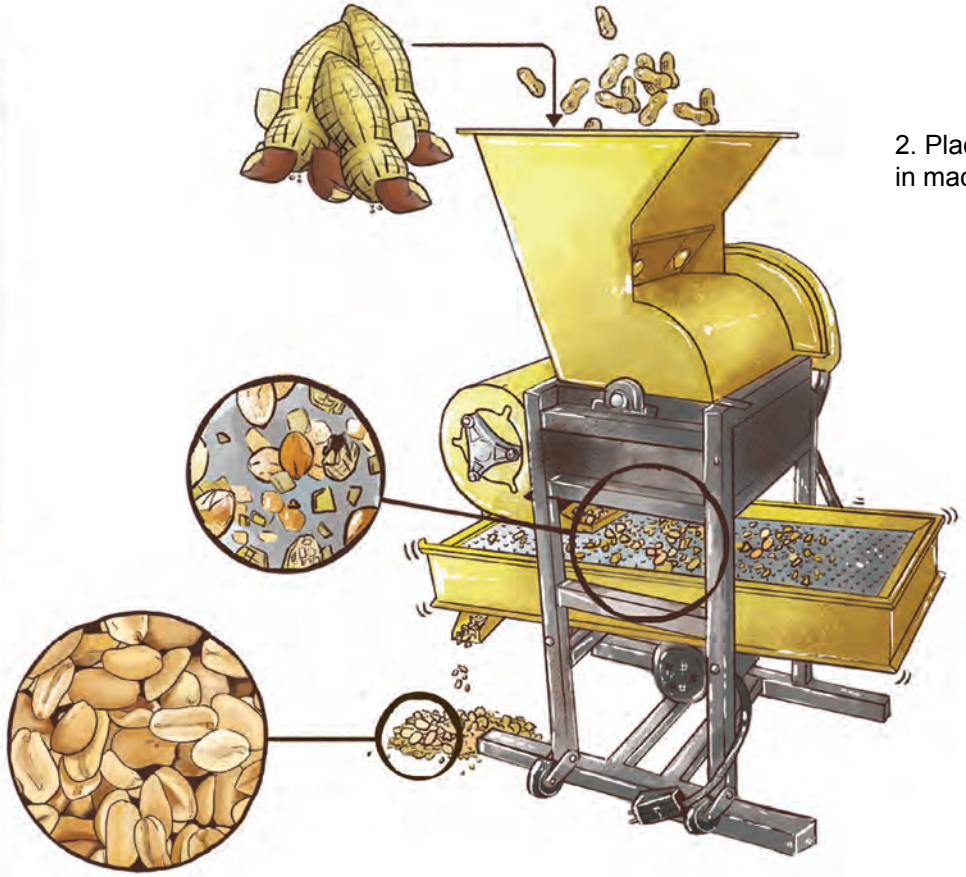


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: New machine from vendor to remove shell from peanuts

1. Purchase from vendor, electric or petrol powered

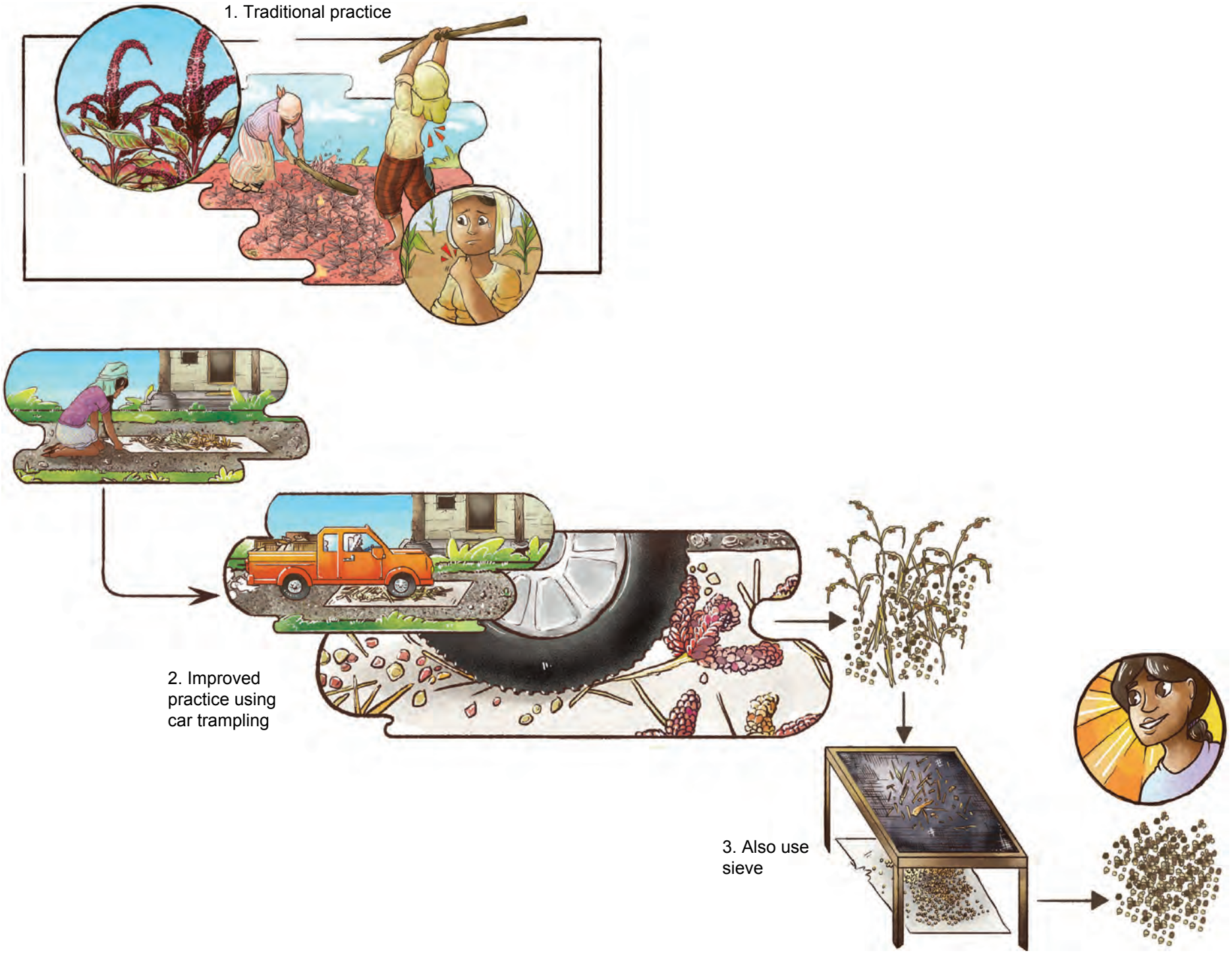




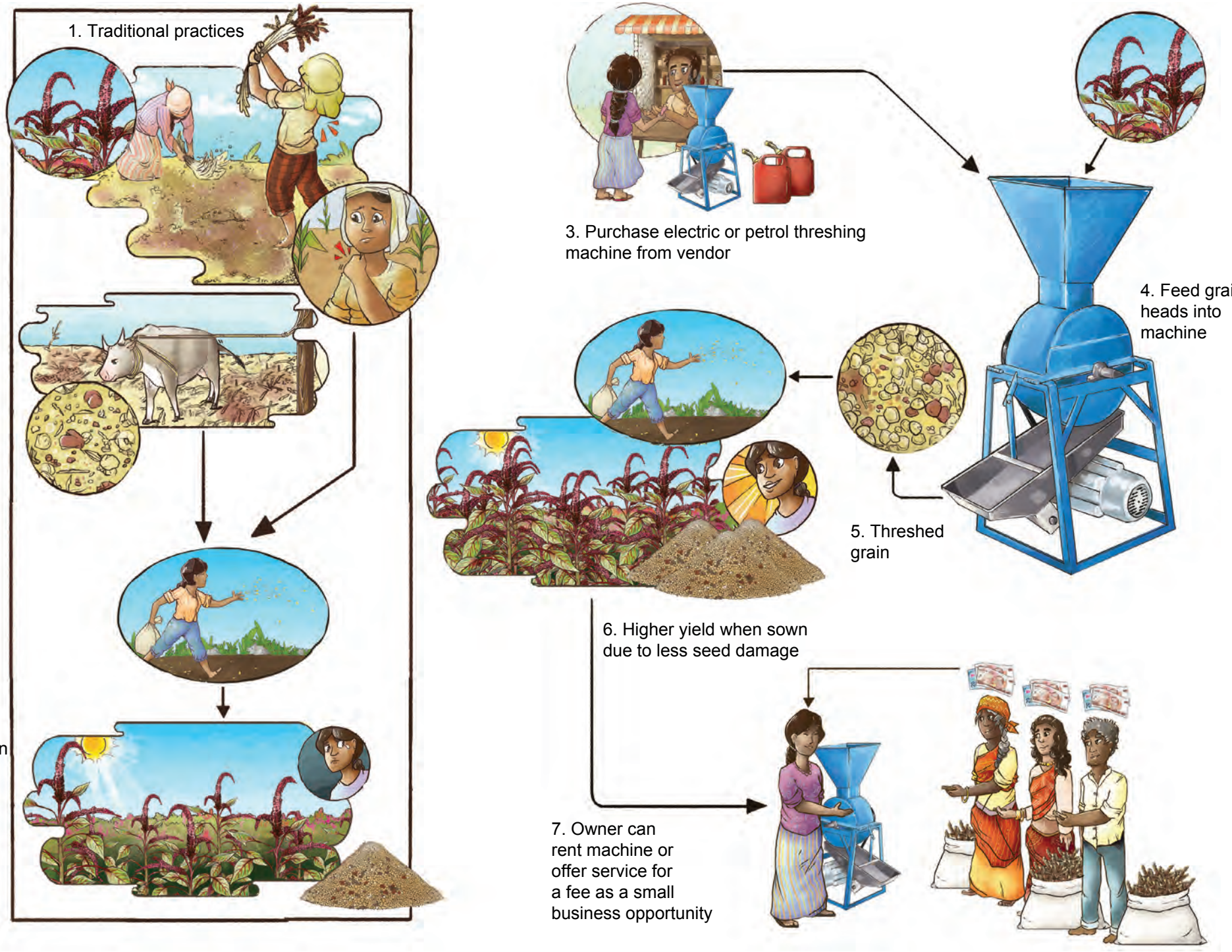
2. Place peanuts in machine

3. Owner can rent machine or offer service for a fee as a small business opportunity

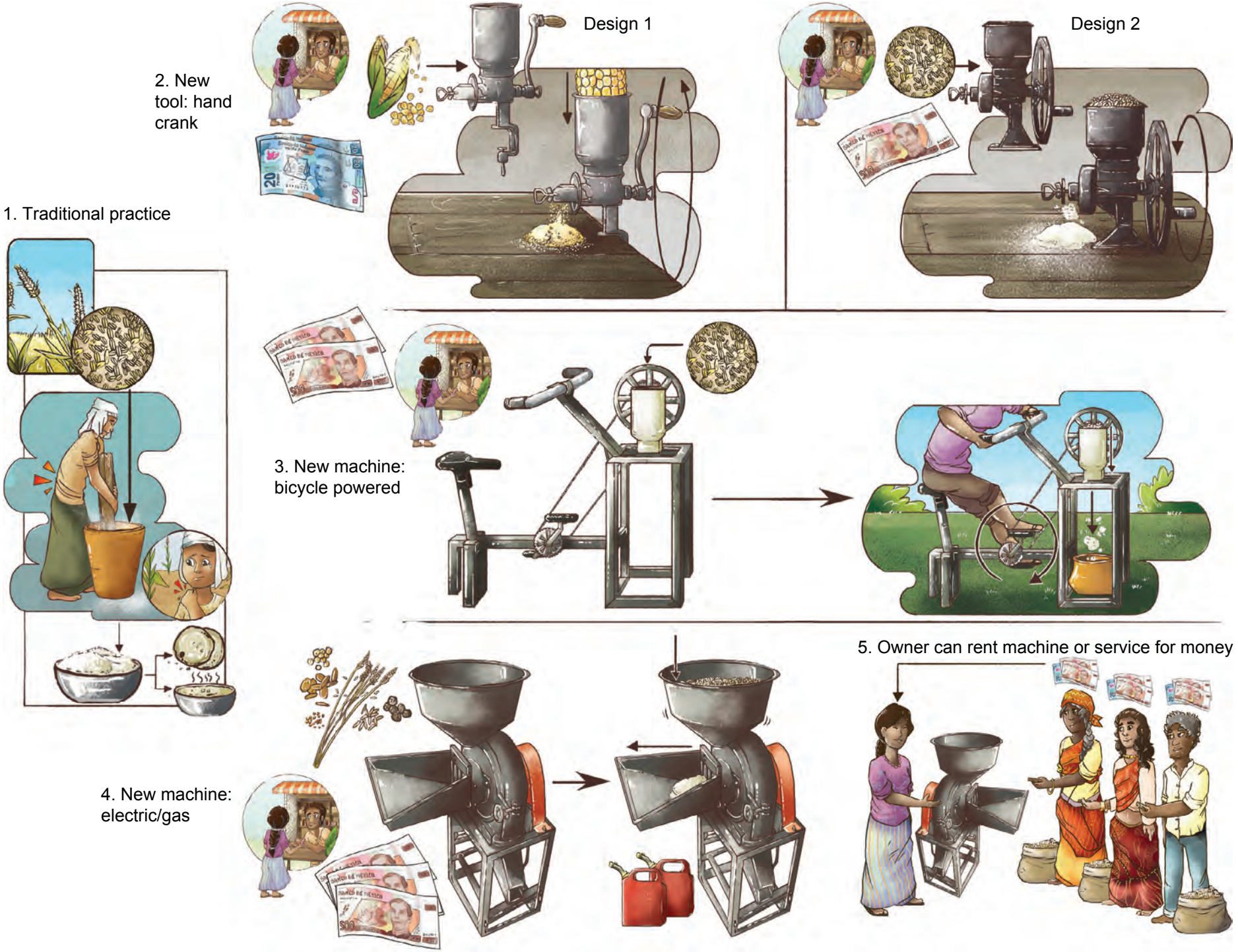
Lesson: Instead of manual threshing of grain, grain may be placed on a road to reduce labour



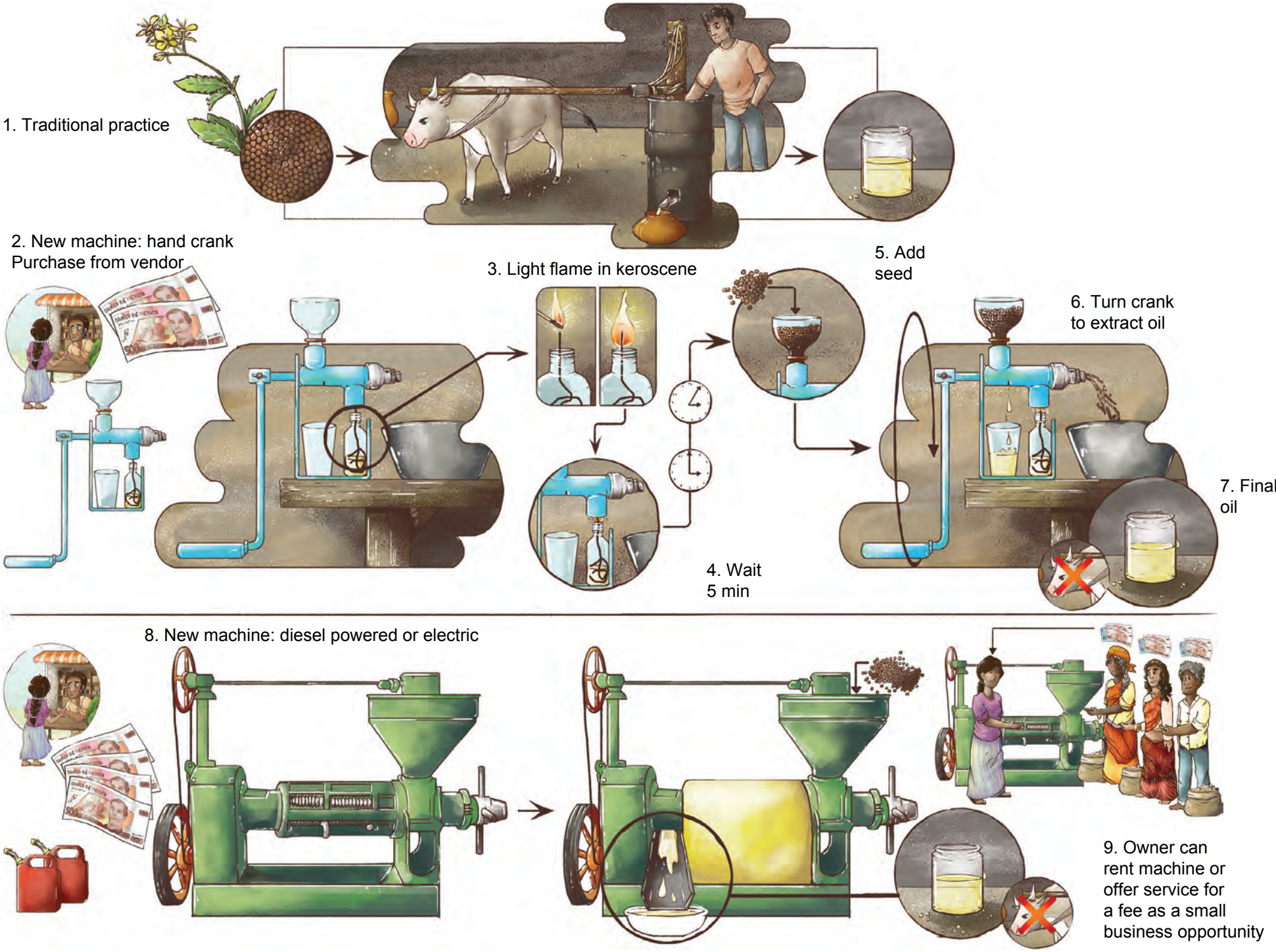
Lesson: Instead of threshing millet grain manually, a machine can be used.



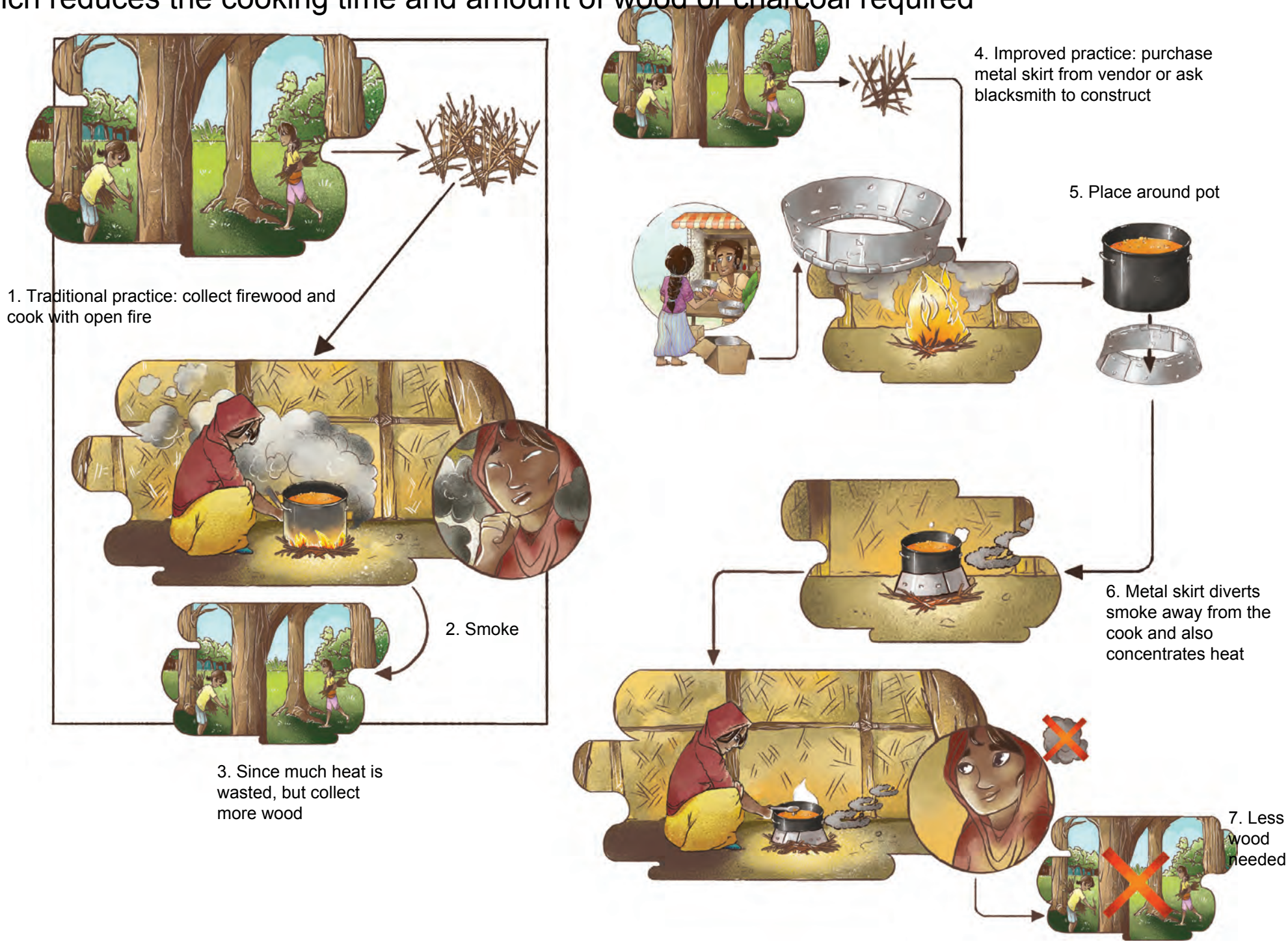
Lesson: To make flour, instead of pounding grain with a stick, there are new machines available



Lesson: New machines may be used to extract cooking oil from seeds

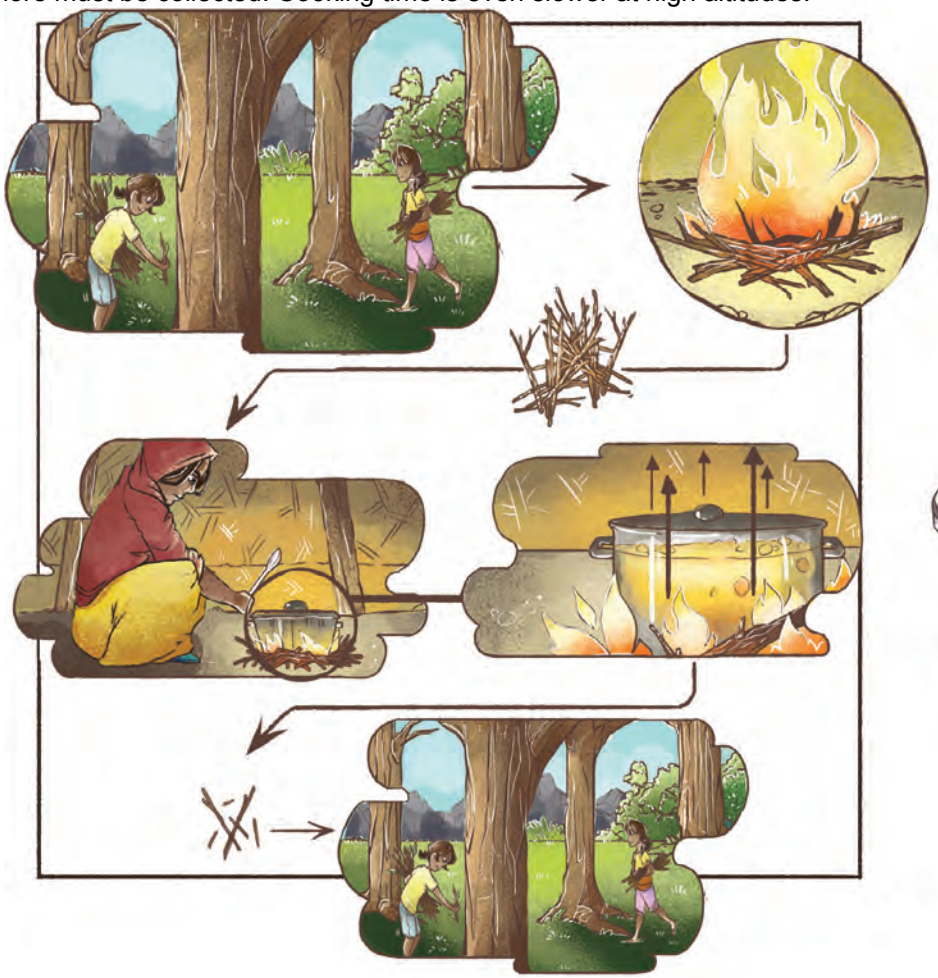


Lesson: Use of a metal skirt around the cooking fire can reduce smoke and raise the heat, which reduces the cooking time and amount of wood or charcoal required



Lesson: Use of a pressure cooker can raise the heat to reduce the cooking time, and the amount of wood or charcoal required especially in high altitudes

1. Traditional practice: collect firewood and cook using a regular pot which cooks at a low temperature and loses heat. Cooking time is slow and consumes firewood so more must be collected. Cooking time is even slower at high altitudes.



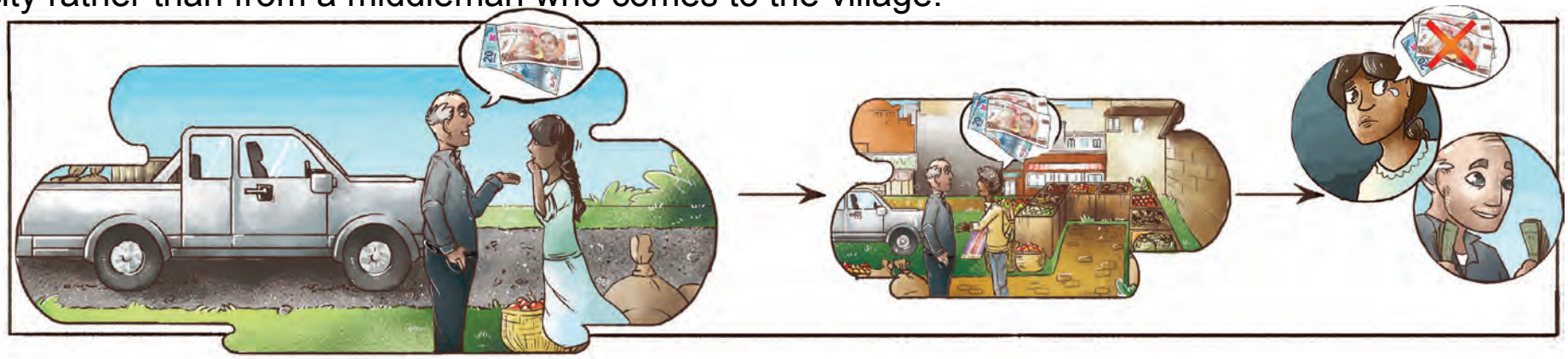
2. Improved practice: purchase pressure cooker from vendor

3. Pot is sealed, so pressure builds, heat does not escape, and temperature is raised above boiling

4. Cooking time is faster, consume less firewood or charcoal, so less wood needs to be collected

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

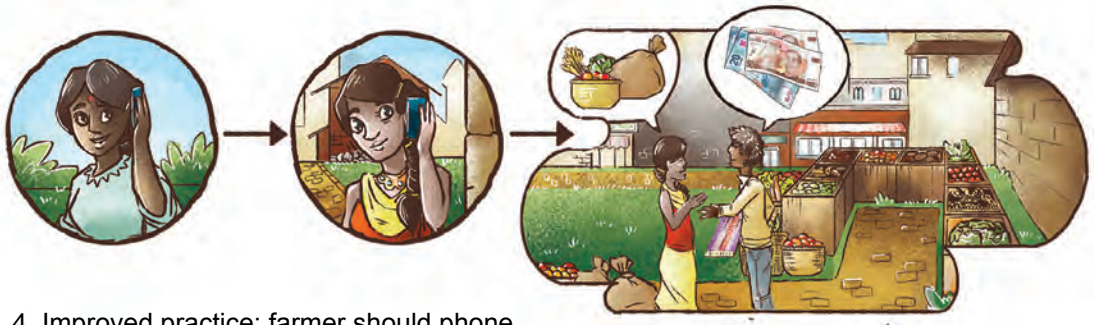
Lesson: It is better to obtain the selling price for farm harvest products from a friend or family member in the city rather than from a middleman who comes to the village.



1. Traditional practice: middleman comes to the village and offers a low price for the farm harvest

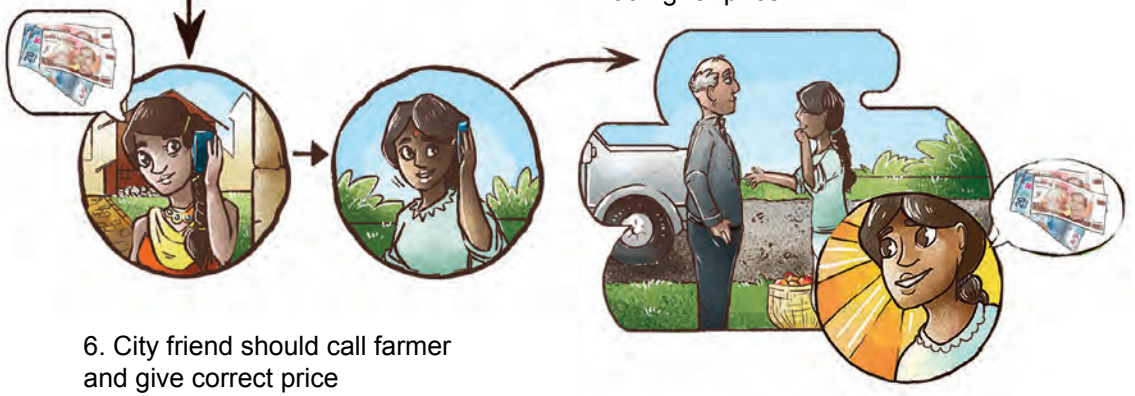
2. Middleman goes to city merchant and sells for a higher price

3. Farmer gets little money, but middleman gets more money



4. Improved practice: farmer should phone friend or relative in the city

5. Friend should speak to merchant in city to inquire about grain price

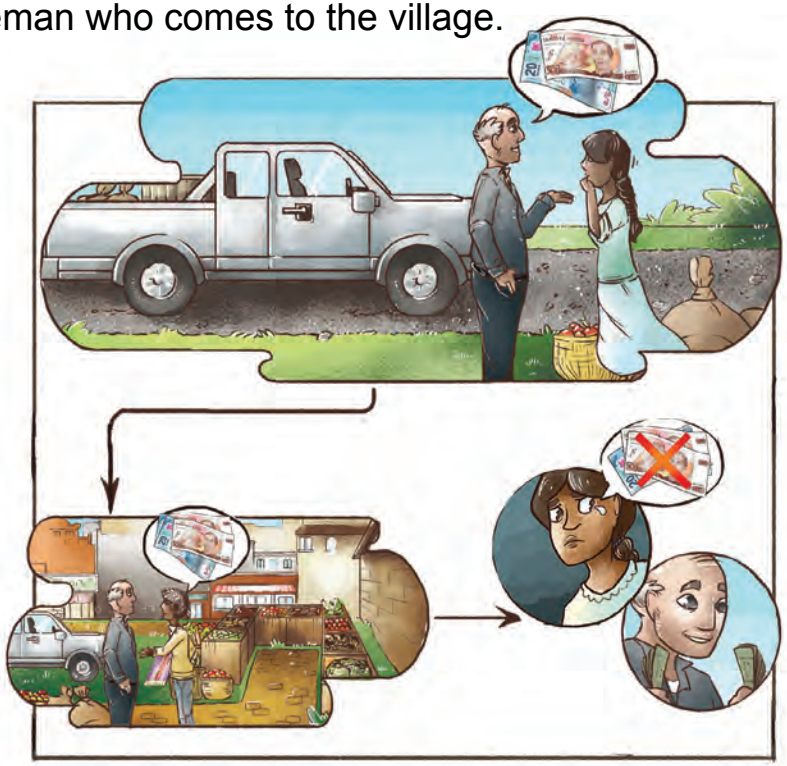


6. City friend should call farmer and give correct price

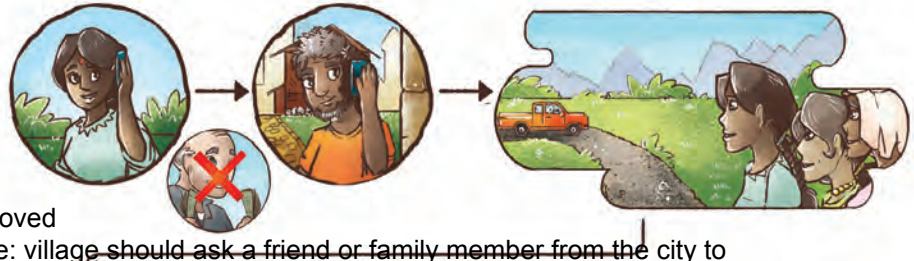
7. Farmer should sell to middleman at higher price

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

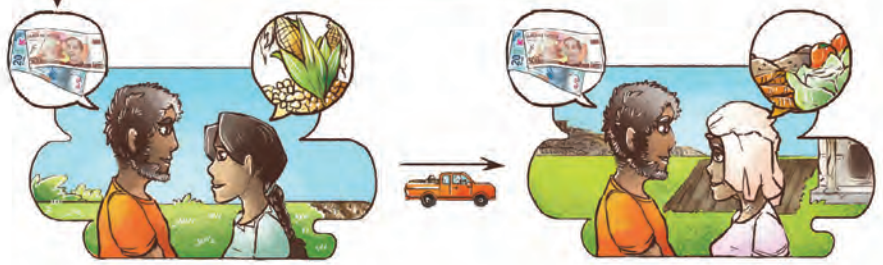
Lesson: It is better to sell farm harvest products directly to a friend or family member who lives in the city rather than to a middleman who comes to the village.



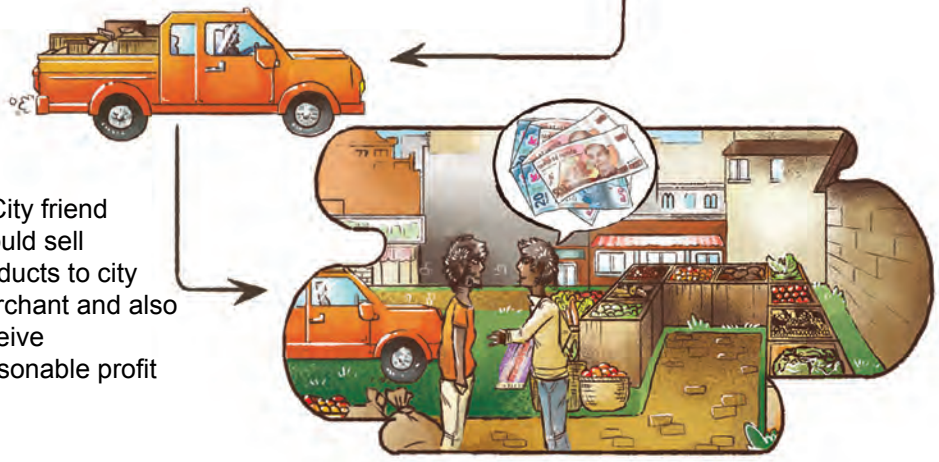
1. Traditional practice: middleman comes to the village and offers a low price for the farm harvest, then middleman goes to city merchant and sells for a higher price.



2. Improved practice: village should ask a friend or family member from the city to come to the village with a truck



3. City friend should buy products from different farmers at a fair price

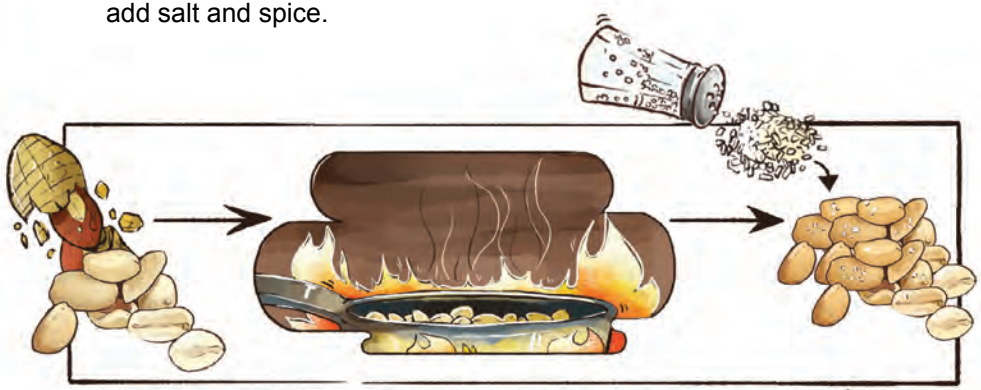


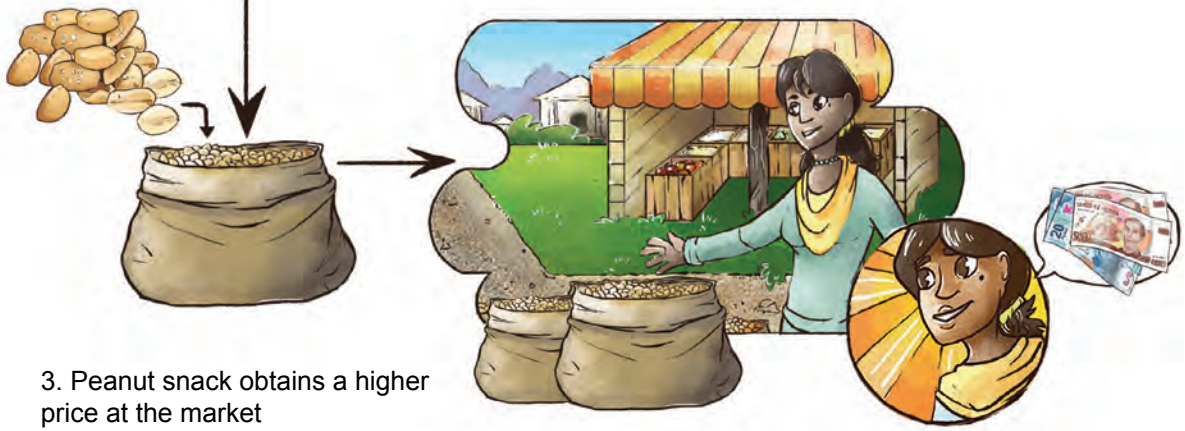
4. City friend should sell products to city merchant and also receive reasonable profit

Lesson: Rather than selling raw harvested products, it is more profitable to sell cooked and tasty snacks

1. Traditional practice: sell uncooked peanuts in the shell. Obtain little money at market.

2. Improved practice: remove peanuts from shell, roast it, then add salt and spice.





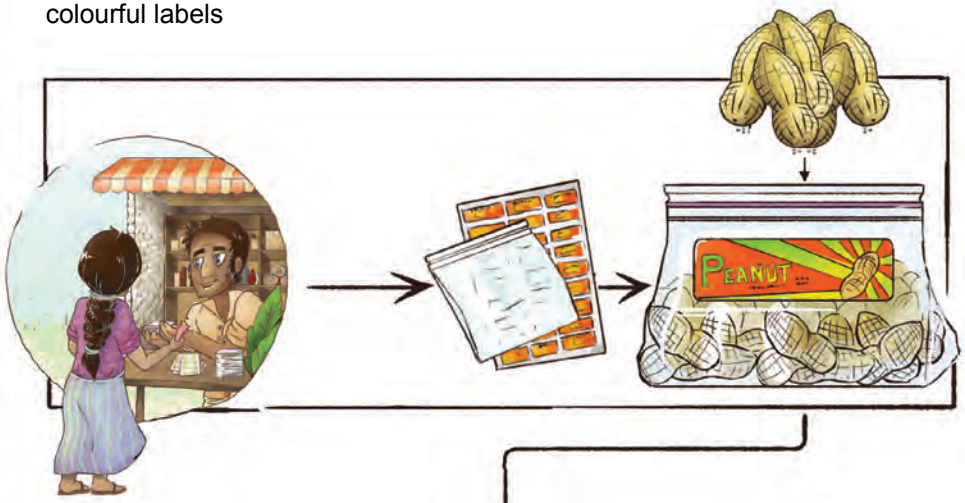
3. Peanut snack obtains a higher price at the market

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Rather than selling harvested products in bulk, it is more profitable to package them beautifully

1. Traditional practice:
sell peanuts in bulk.
Obtain little money at market.

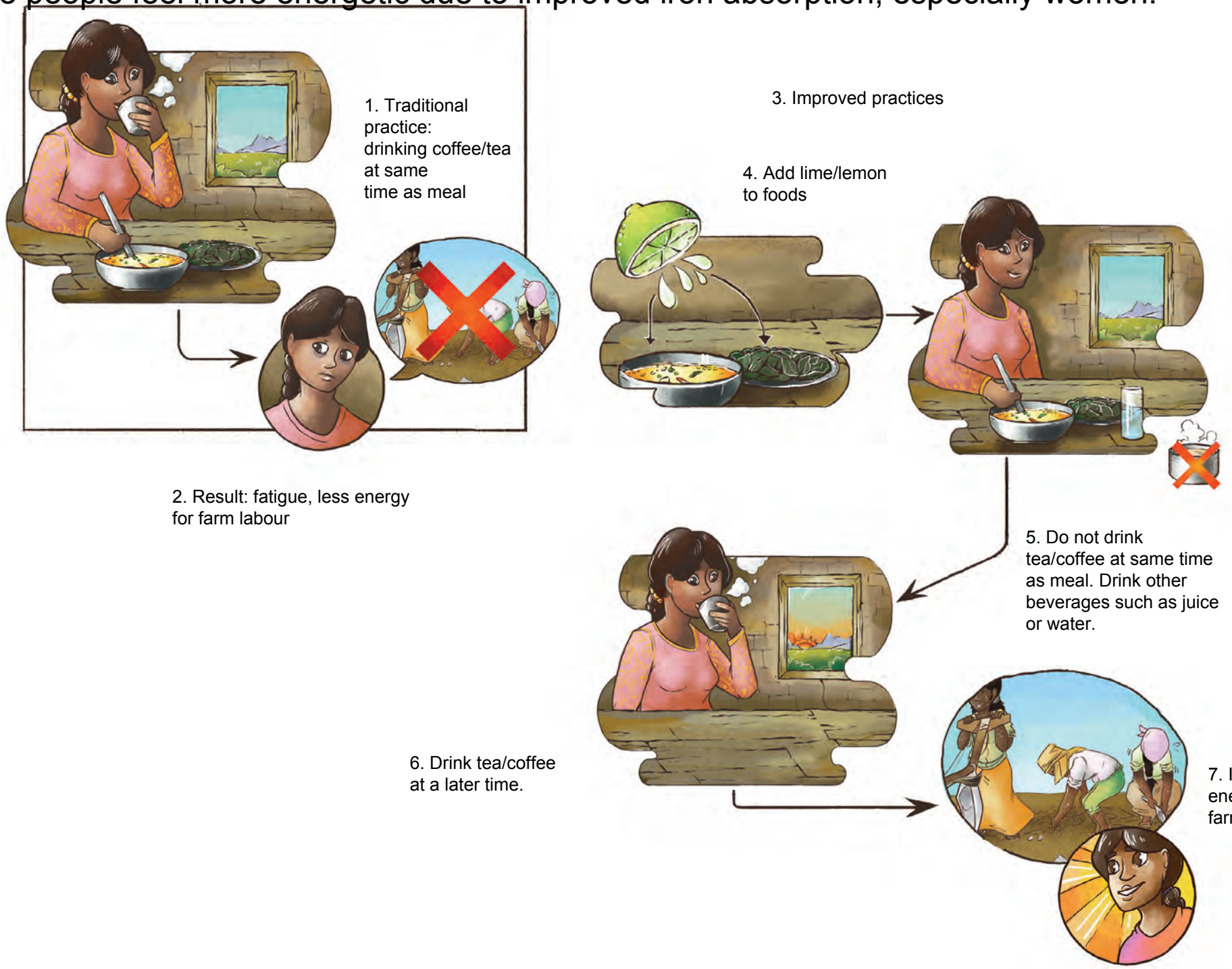
2. Improved practice: place peanuts in packages with beautiful, colourful labels



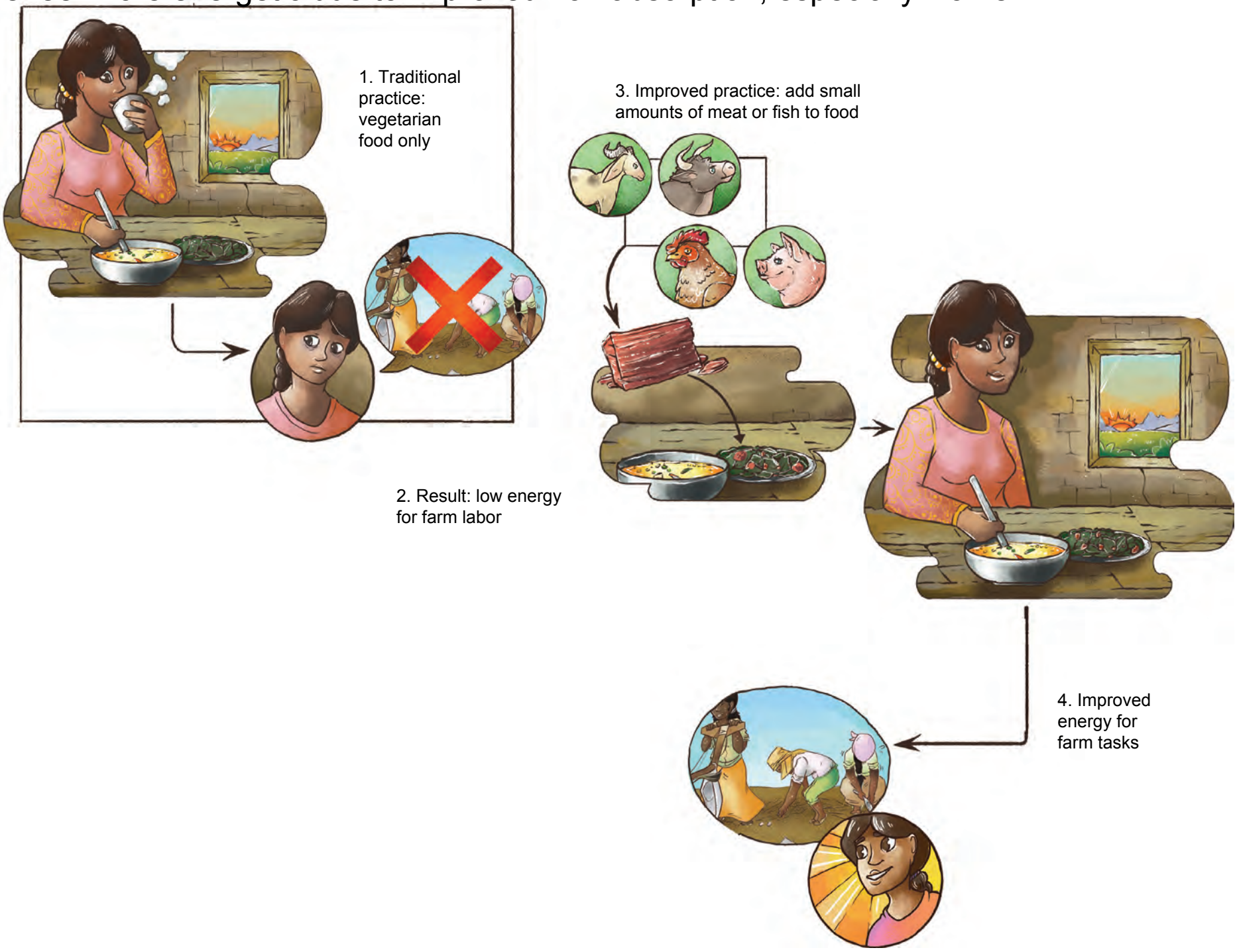
3. Packaged peanuts obtain a higher price at the market

Chapter 10: **Human Nutrition**

Lesson: Not drinking coffee/tea at the same time as meals, and adding lemon/lime to food, will make people feel more energetic due to improved iron absorption, especially women.



Lesson: Adding small amounts of meat or fish to vegetarian food (if beliefs permit) will make people feel more energetic due to improved iron absorption, especially women.

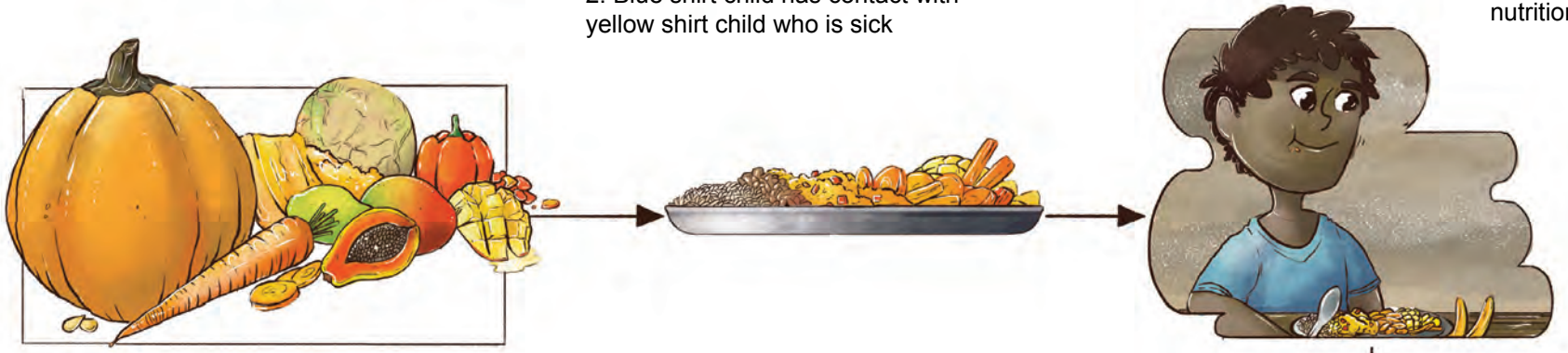


Lesson: Eating a diversity of colourful foods will prevent people from catching diseases

1. Less recommended: Blue-shirt child eats maize, rice, or tubers only

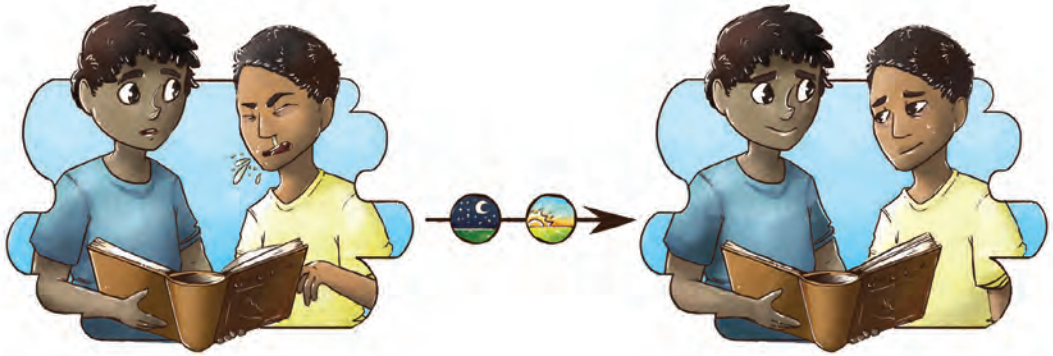
2. Blue shirt child has contact with yellow shirt child who is sick

3. Blue shirt child is more likely to catch disease due to poor nutrition



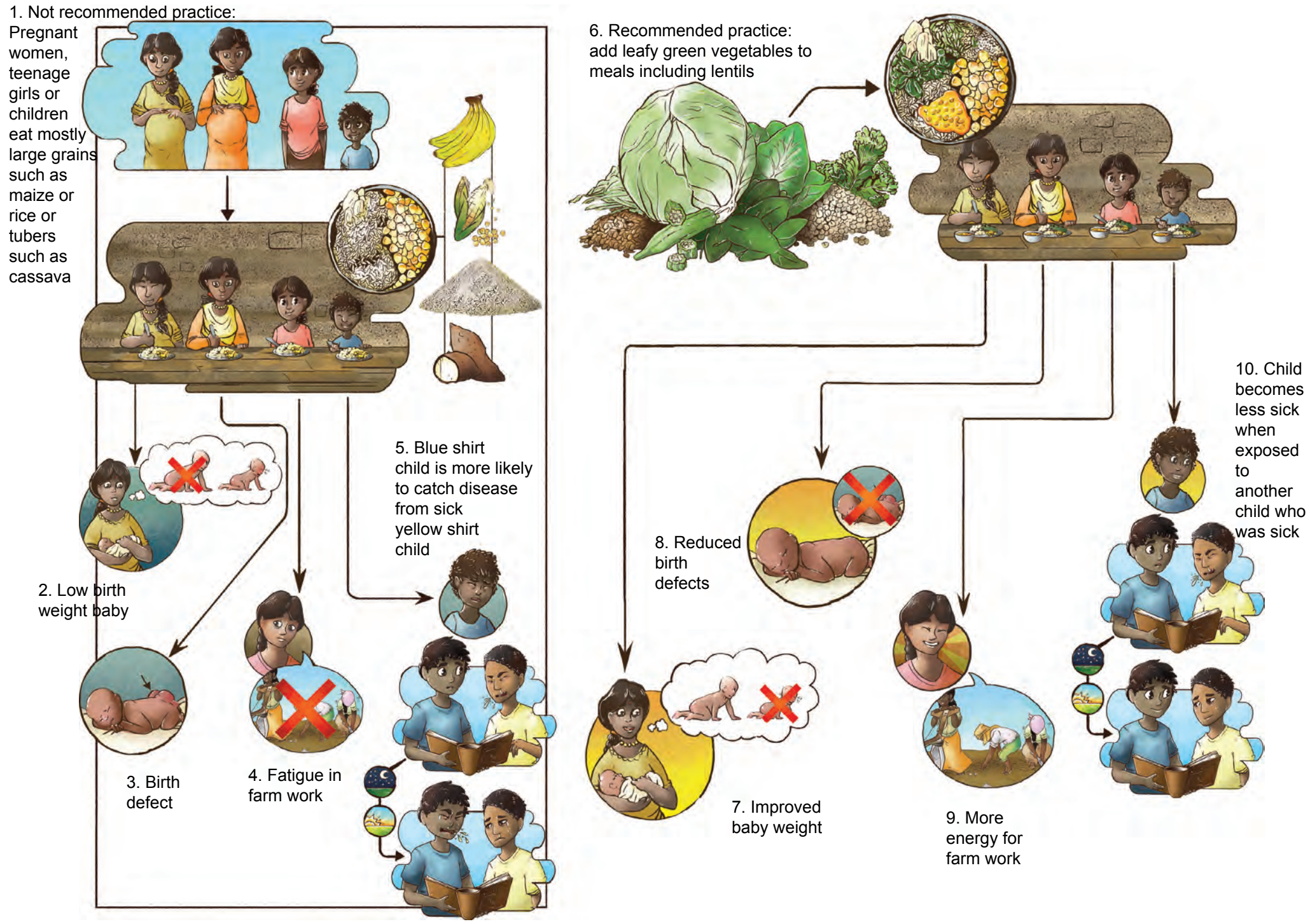
4. Solution: eat a diversity of colourful foods which help to fight diseases.

5. Blue shirt child eats colourful foods



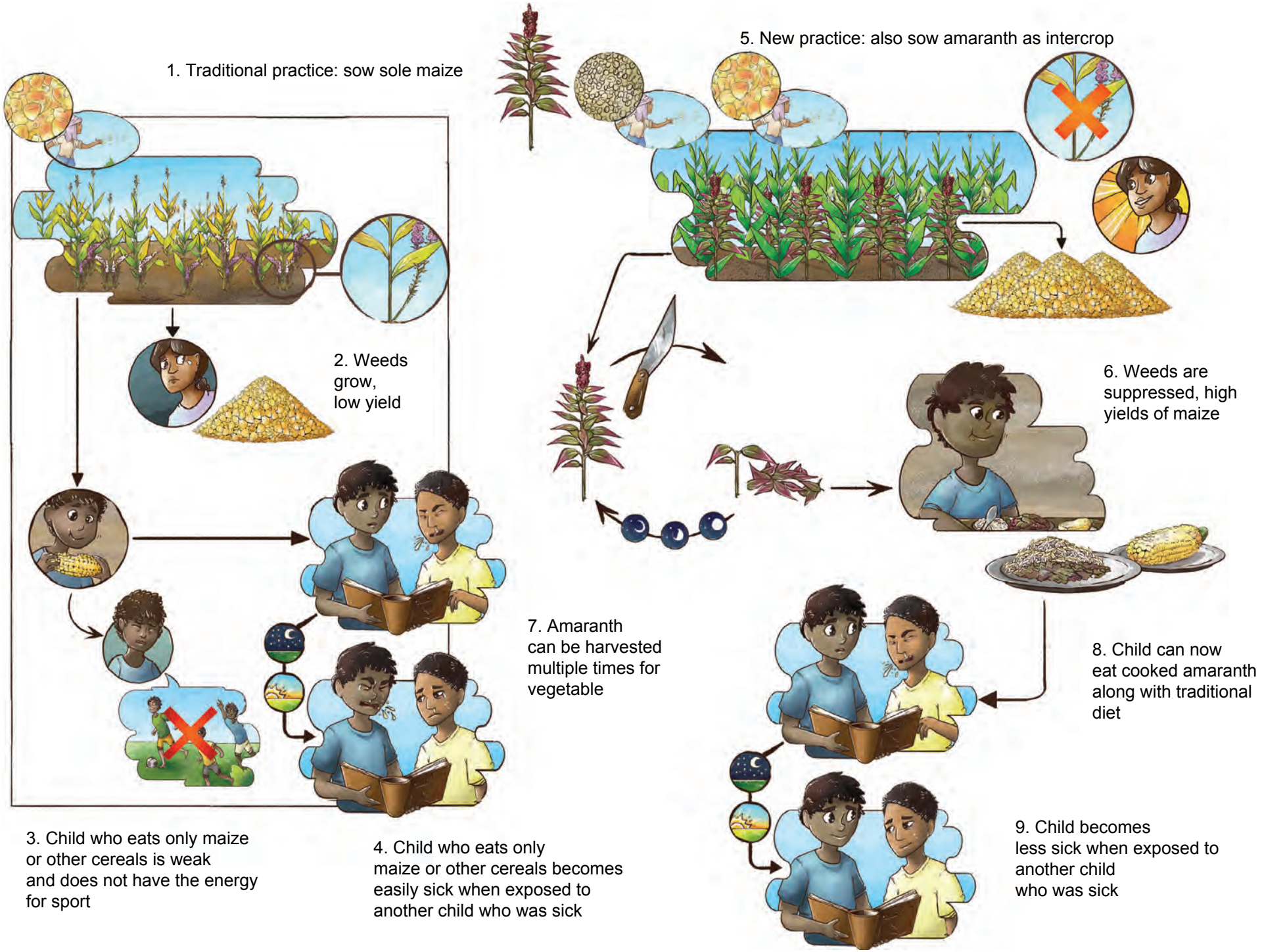
6. Blue shirt child less likely to become sick after contact with sick yellow shirt child

Lesson: Pregnant women and children should eat leafy green vegetables

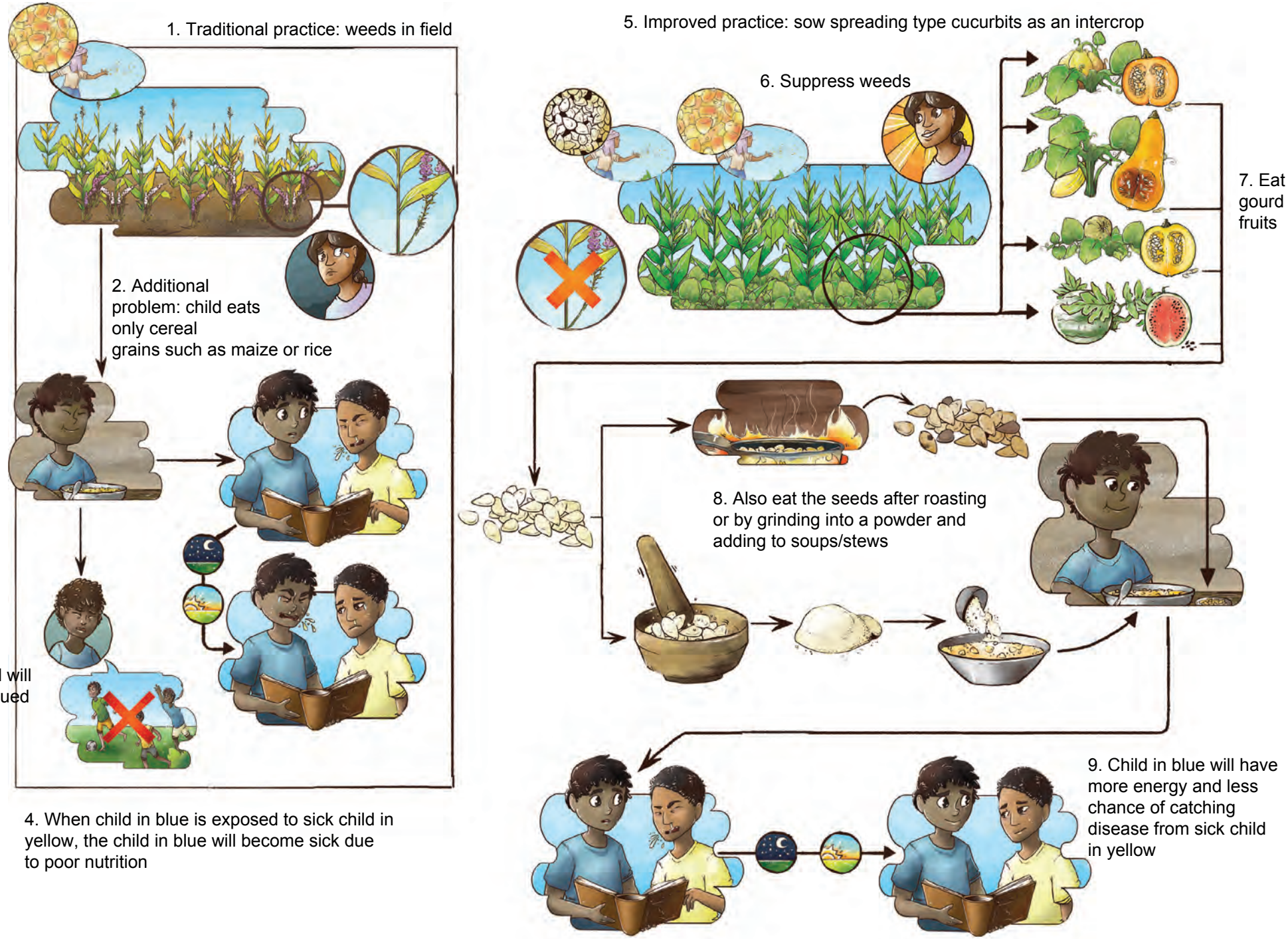


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

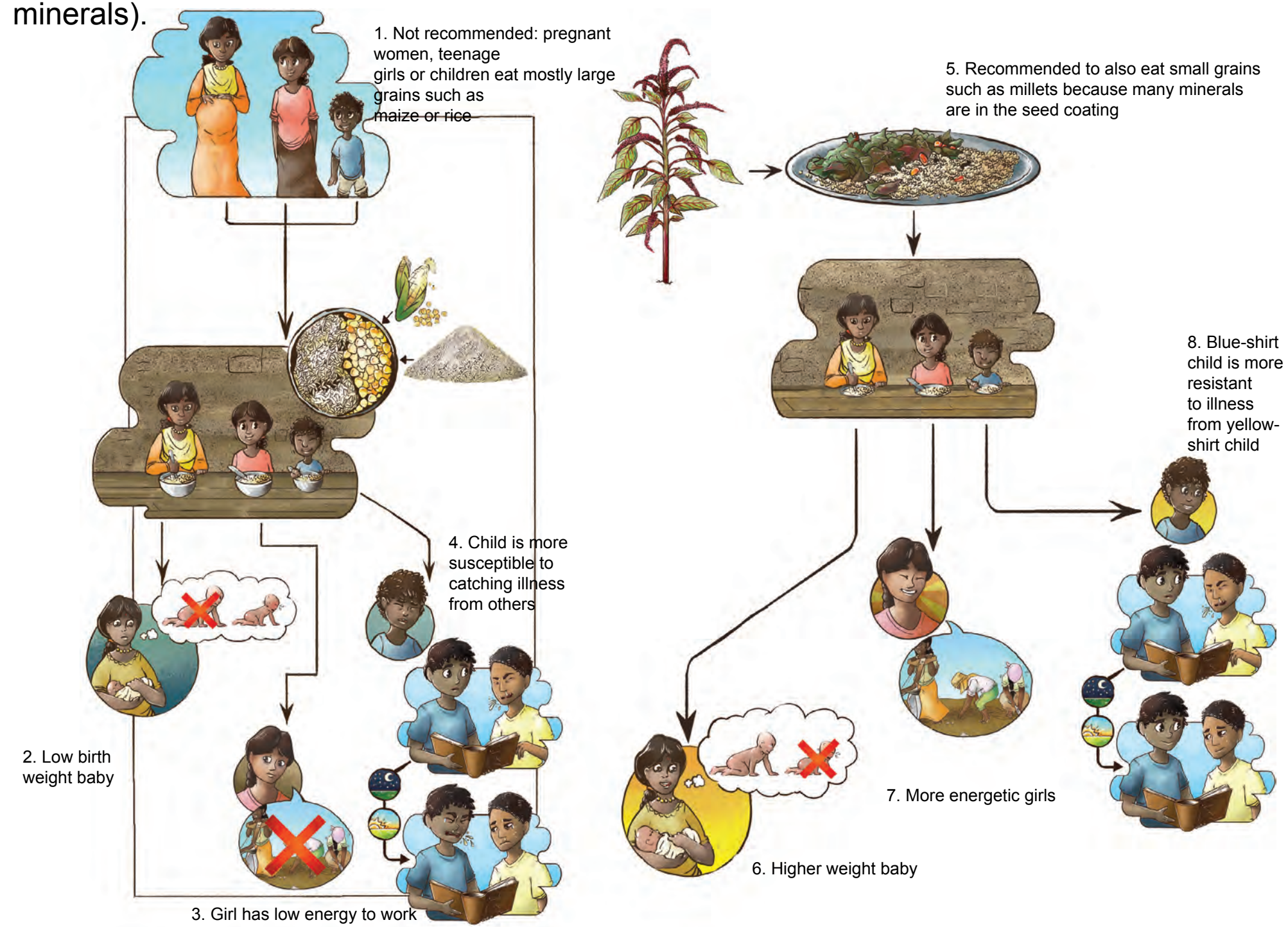
Lesson: Amaranth is fast, easy to grow, can suppress weeds and adds nutrients to human diets



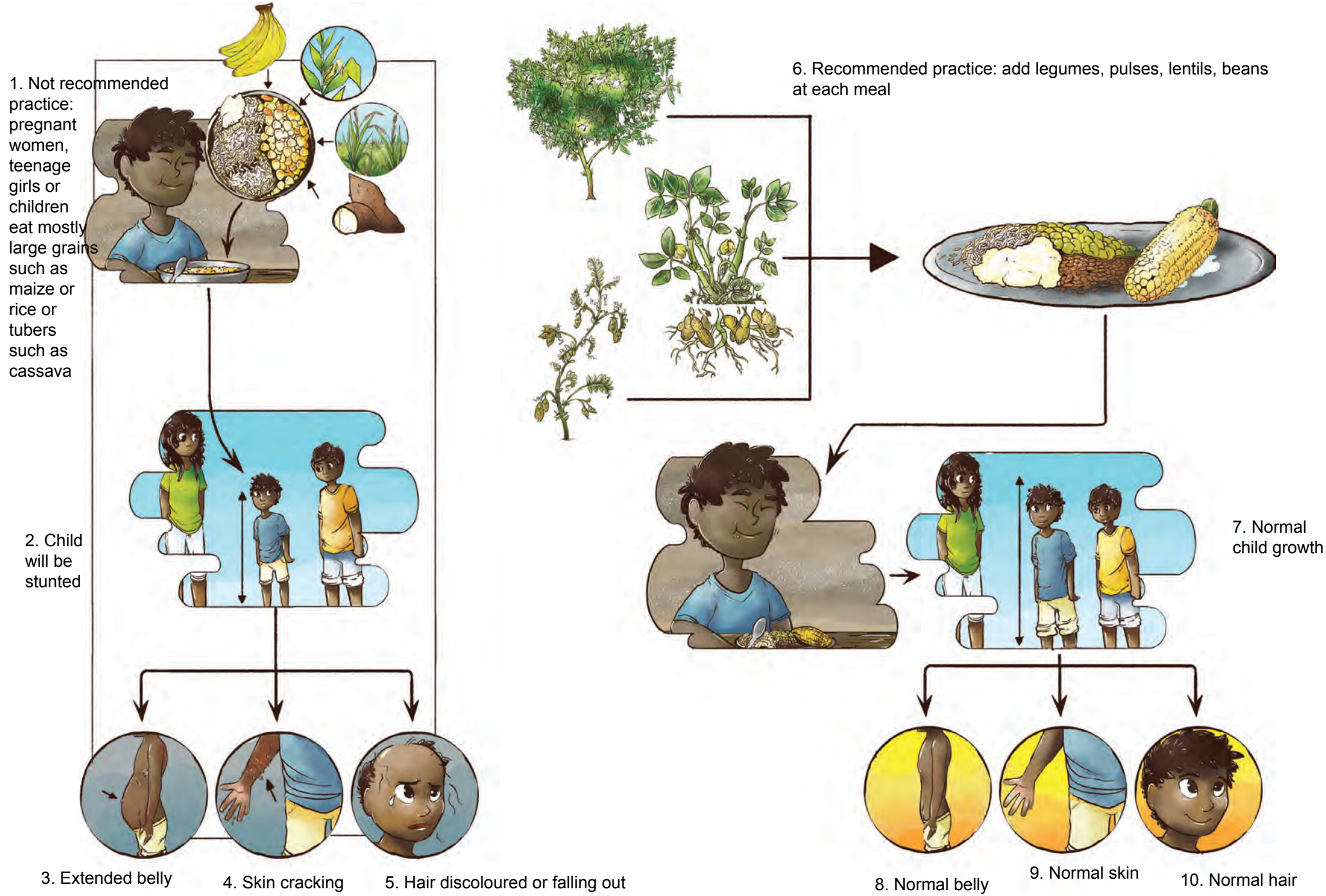
Lesson: Cucurbit intercrops suppress weeds and provide nutrients to reduce disease in people



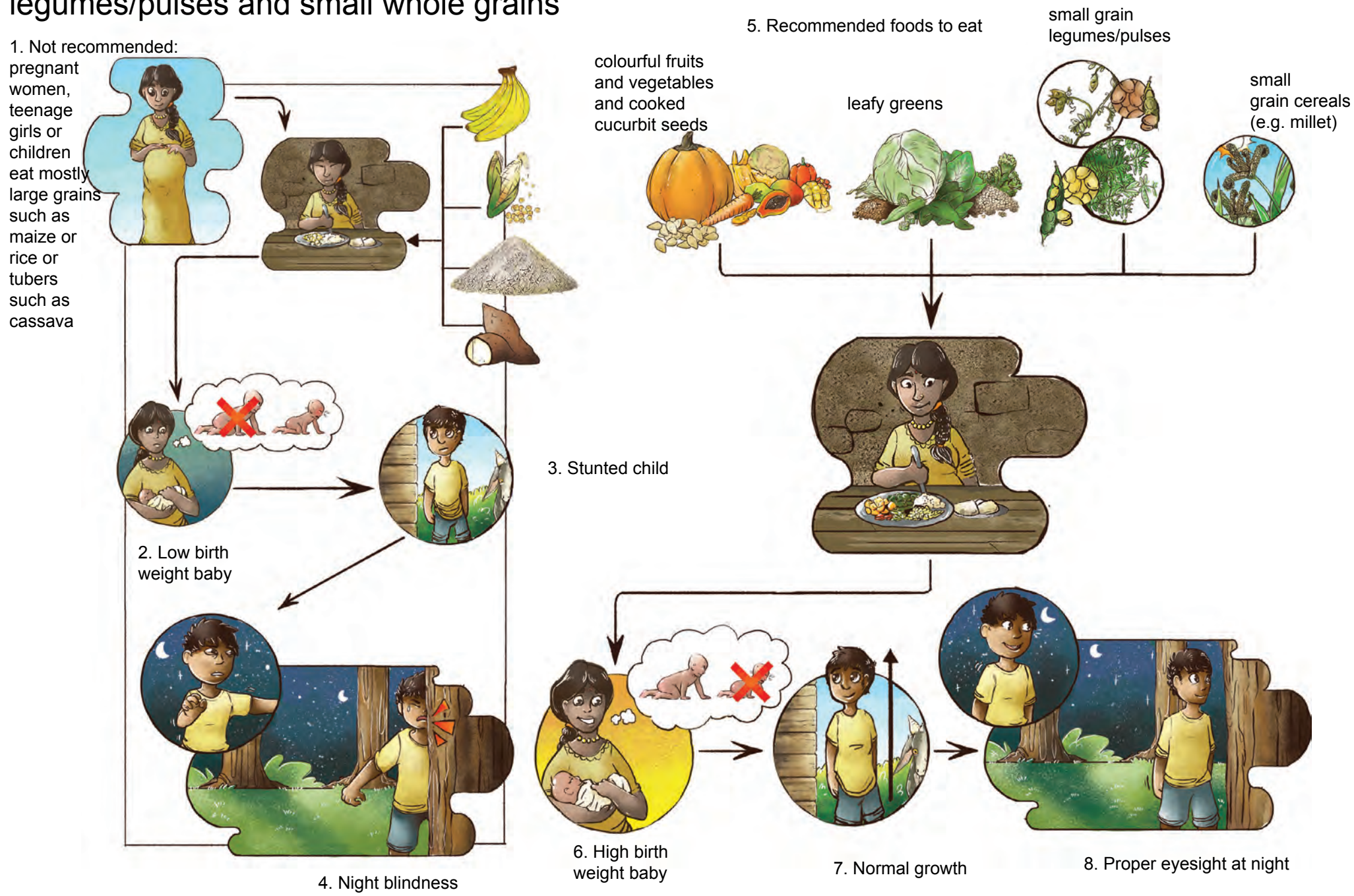
Lesson: Pregnant women and children should eat whole small grains to be healthier (folate and minerals).



Lesson: People especially pregnant women and children should eat legumes/pulses



Lesson: Pregnant women and children should eat colourful foods, leafy green vegetables, legumes/pulses and small whole grains



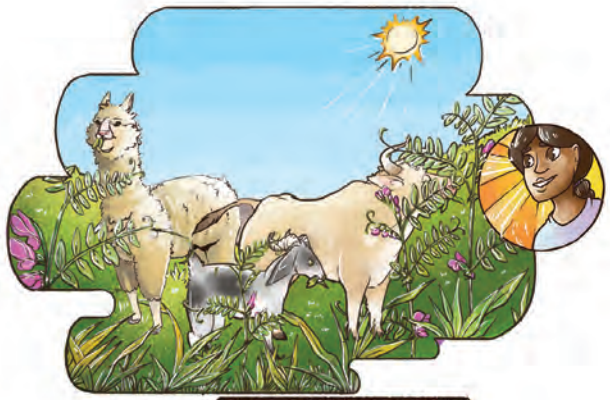
Chapter 11: **Animals**

Lesson: In the dry season, vetch can grow and provide fodder for livestock

1. Traditional problem is lack of feed for animals in dry season

2. Improved practice:
Sow vetch seeds and grasses before dry season

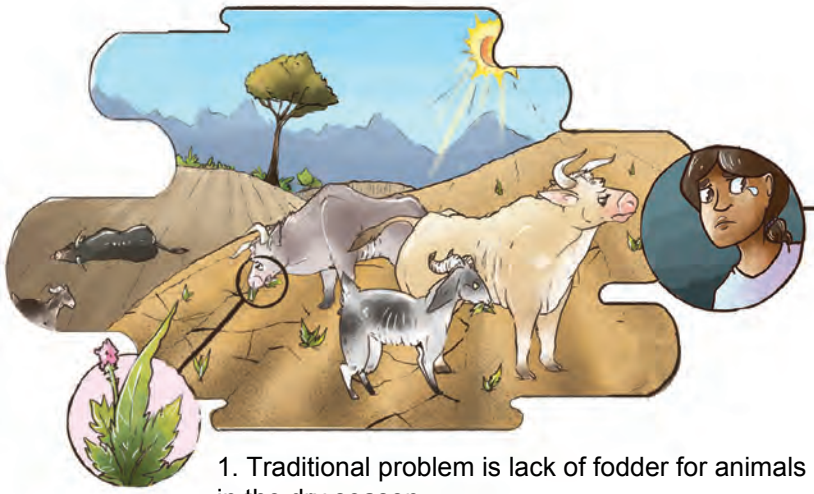
3. Animals have feed in dry season



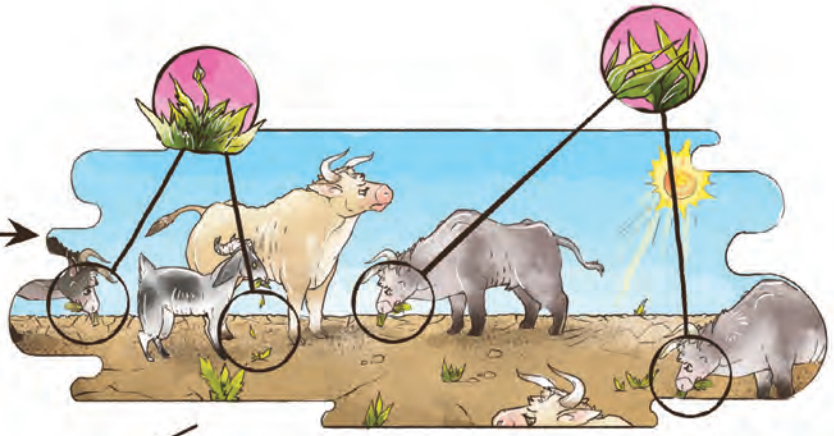
4. Roots of vetch have pink spheres which produce natural fertilizer which feeds next season crop

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

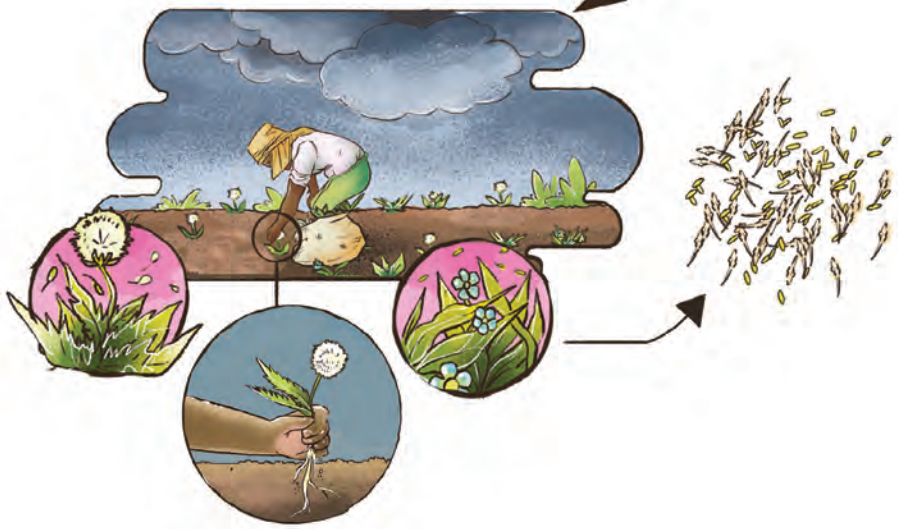
Lesson: Observe which plants grow in the dry season, then deliberately grow them, to provide livestock fodder



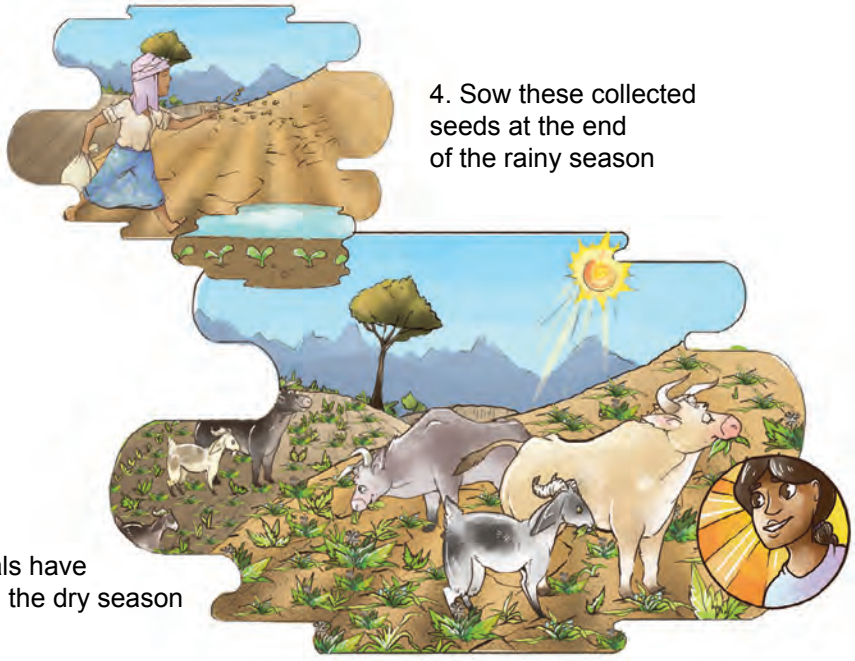
1. Traditional problem is lack of fodder for animals in the dry season



2. Improved practice: observe by eye which grasses and plants with pods that can grow in the dry season, and which livestock eat



3. Collect these seeds after they flower

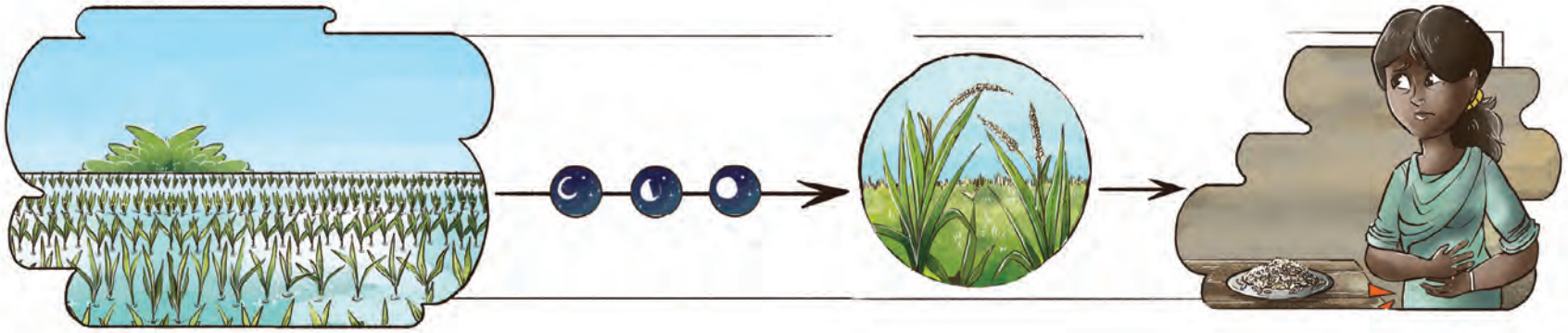


4. Sow these collected seeds at the end of the rainy season

5. Animals have fodder in the dry season

Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Rather than being hungry before the rice harvest, grow fish in the rice paddies and eat them.



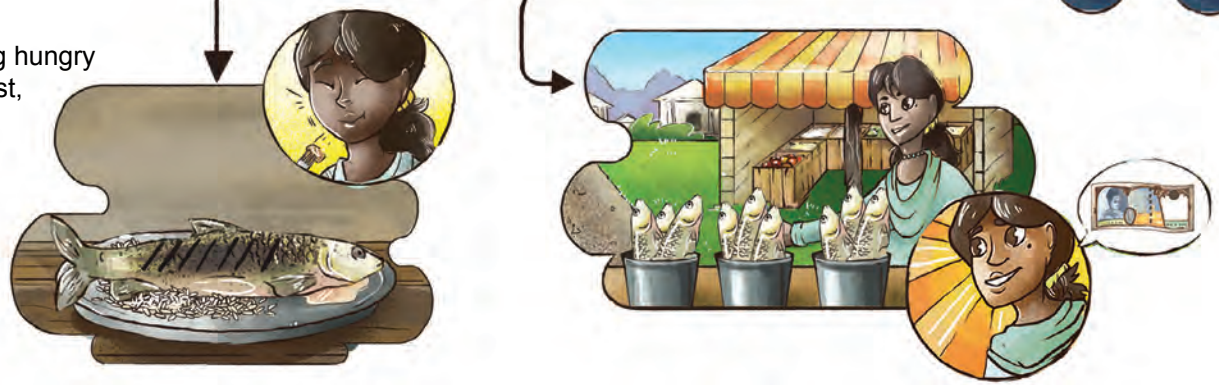
1. Traditional problem:
rice to grain harvest requires many months

2. Hunger before rice is harvested

3. Improved practice:
stock fish hatchlings
in rice paddy

4. Fish will deposit manure
to help feed rice and
therefore reduce need
to purchase fertilizer

5. Instead of being hungry
prior to rice harvest,
catch and eat fish

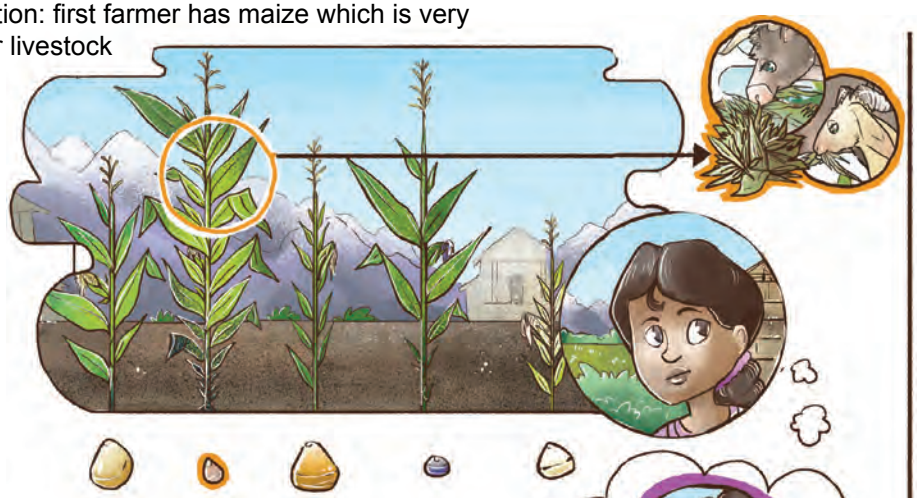


Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Chapter 12: **Crop Breeding**

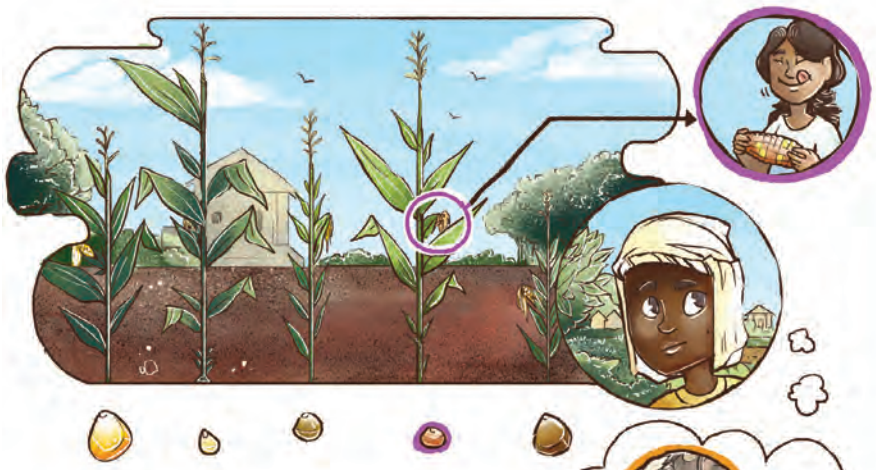
Lesson: Exchanging seeds with farmers from other villages can be beneficial.

1. Situation: first farmer has maize which is very good for livestock



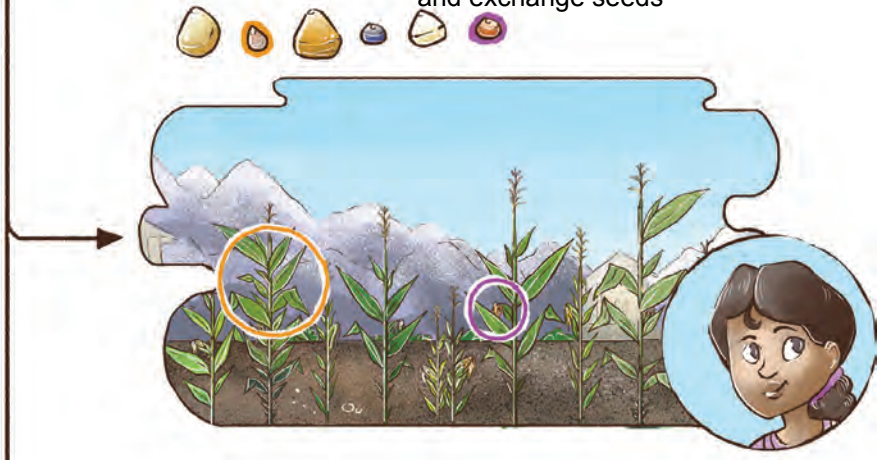
2. First farmer wants maize which is tastier or healthier for humans

3. Second farmer in nearby village has maize which is tastier for humans

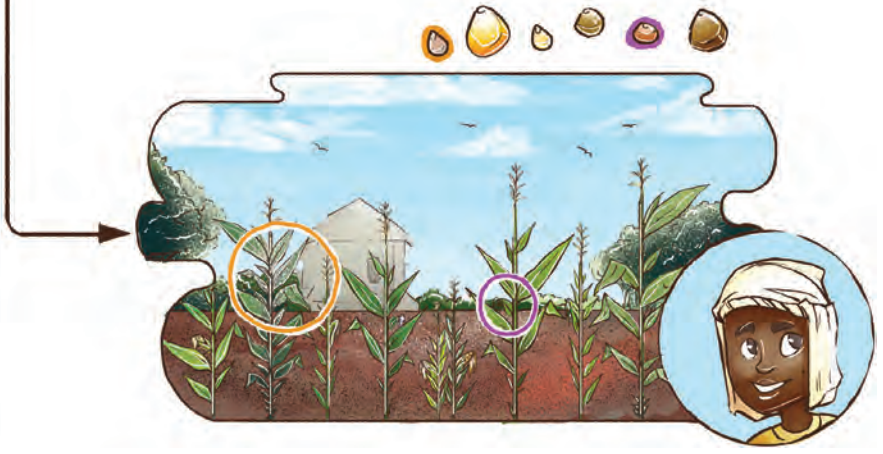


4. Second farmer wants maize which is very good for livestock

5. Solution: the two farmers meet and exchange seeds

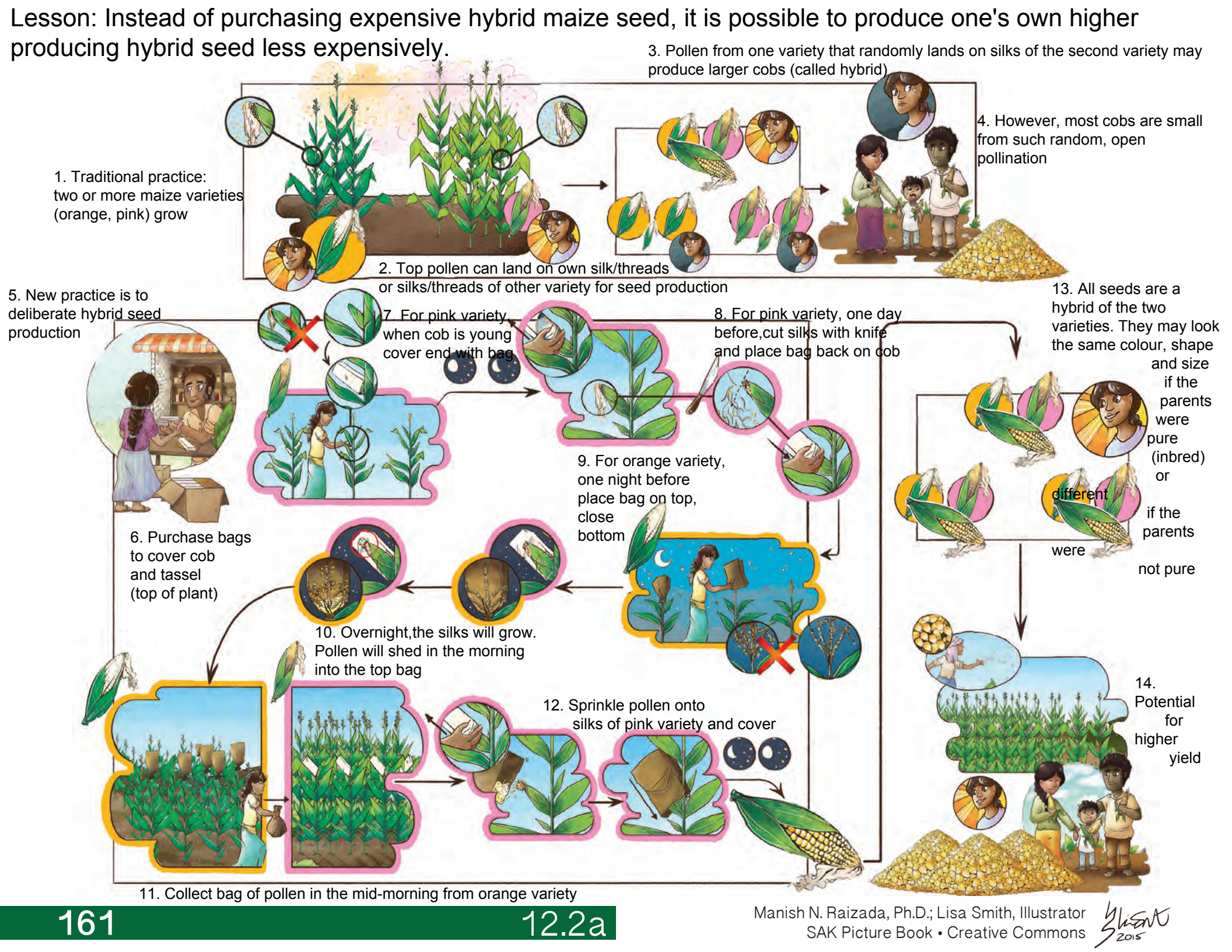


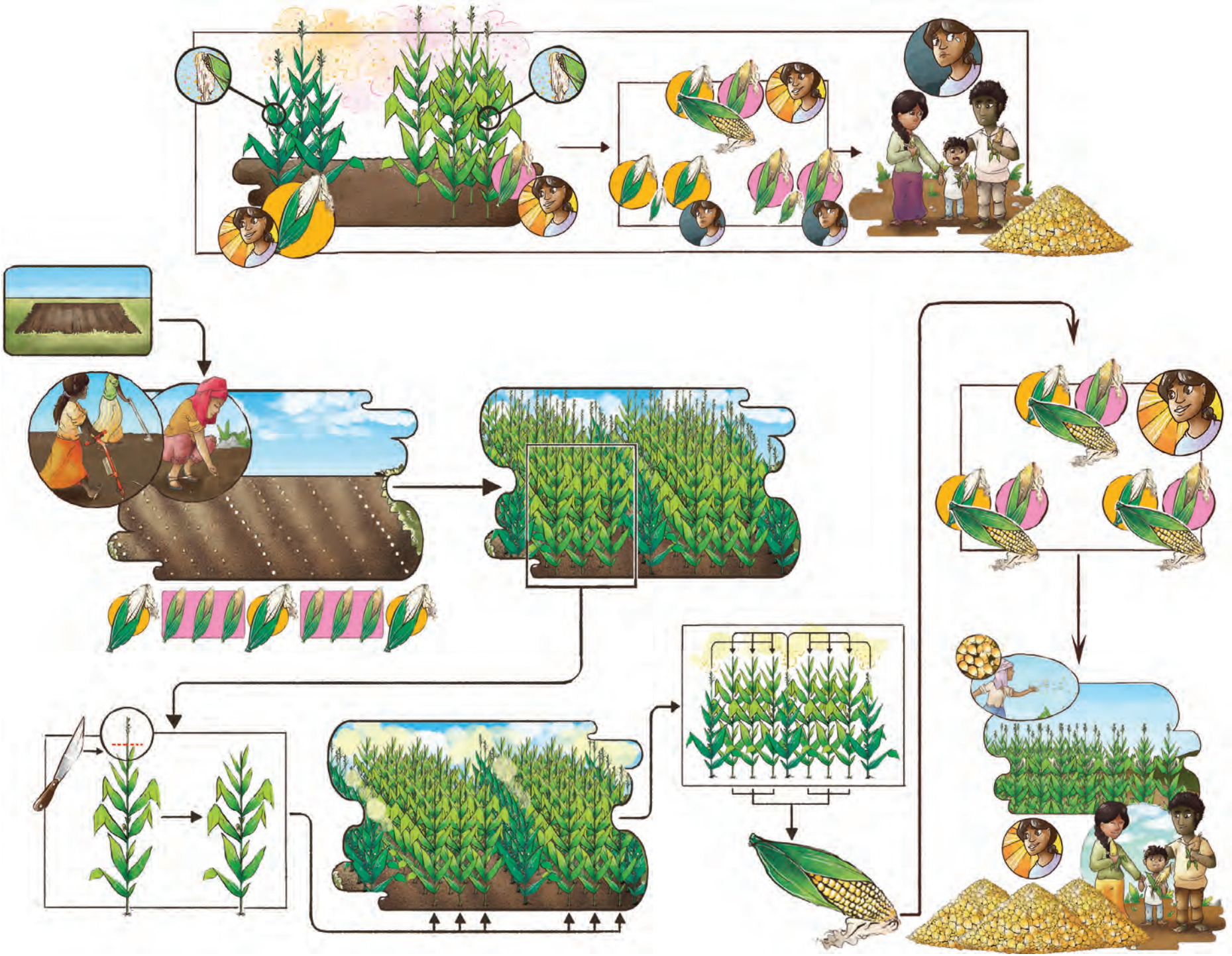
6. Now both farmers have best maize for all purposes



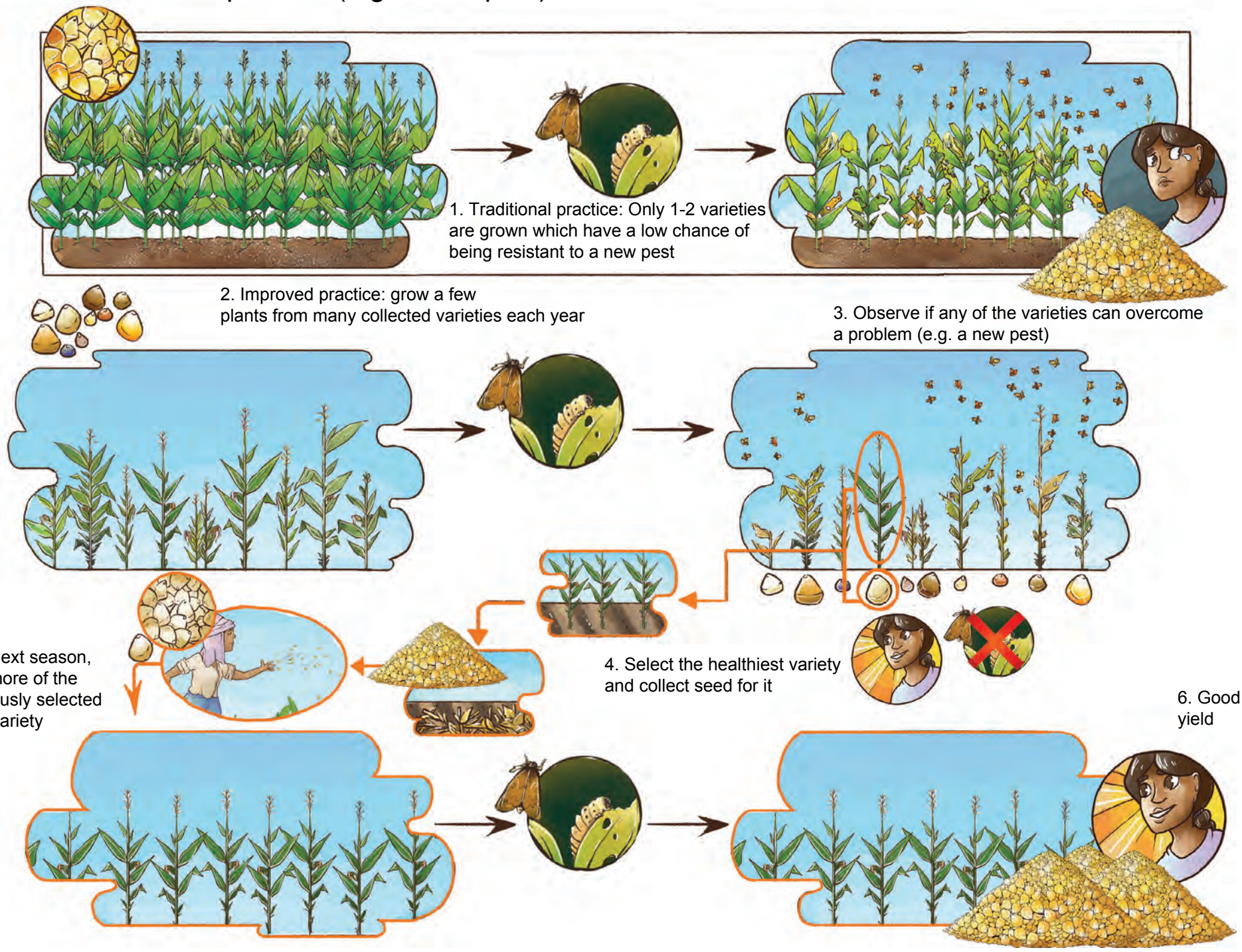
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: Instead of purchasing expensive hybrid maize seed, it is possible to produce one's own higher producing hybrid seed less expensively.



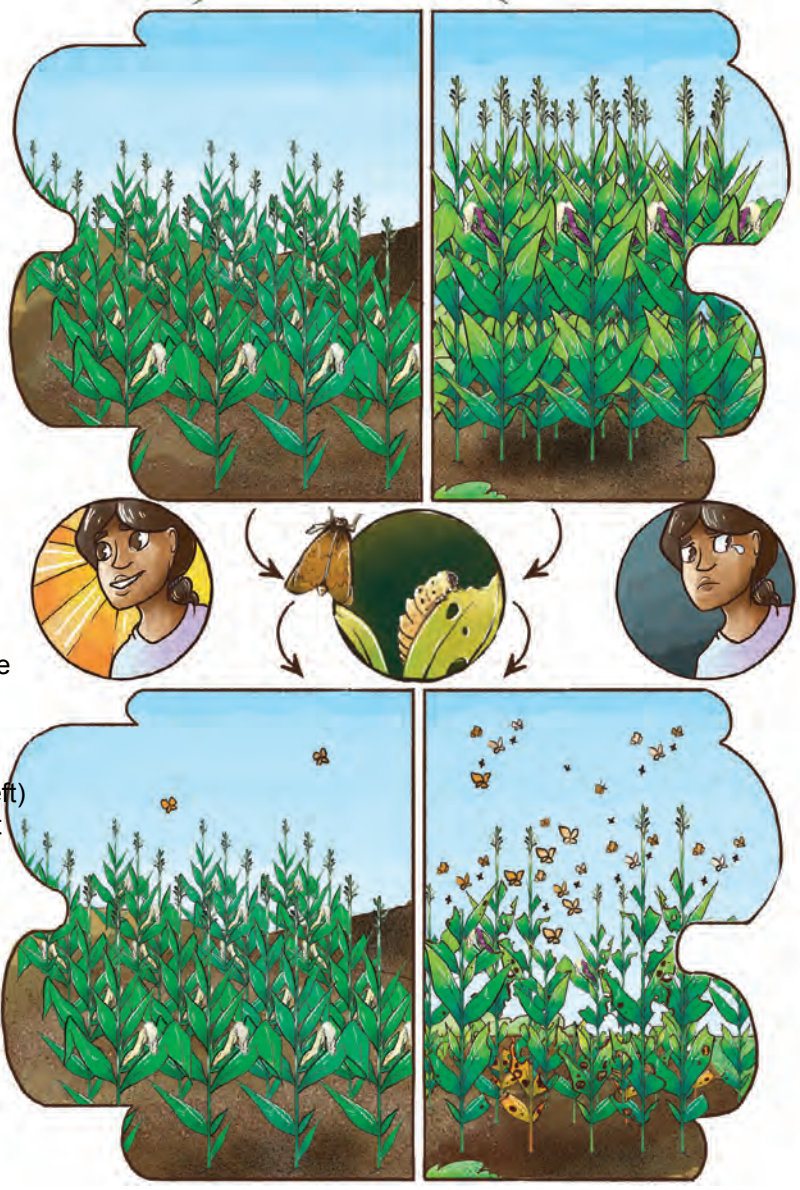


Lesson: It is useful to maintain multiple varieties of each crop in order to test whether a particular variety may overcome a new problem (e.g. a new pest).

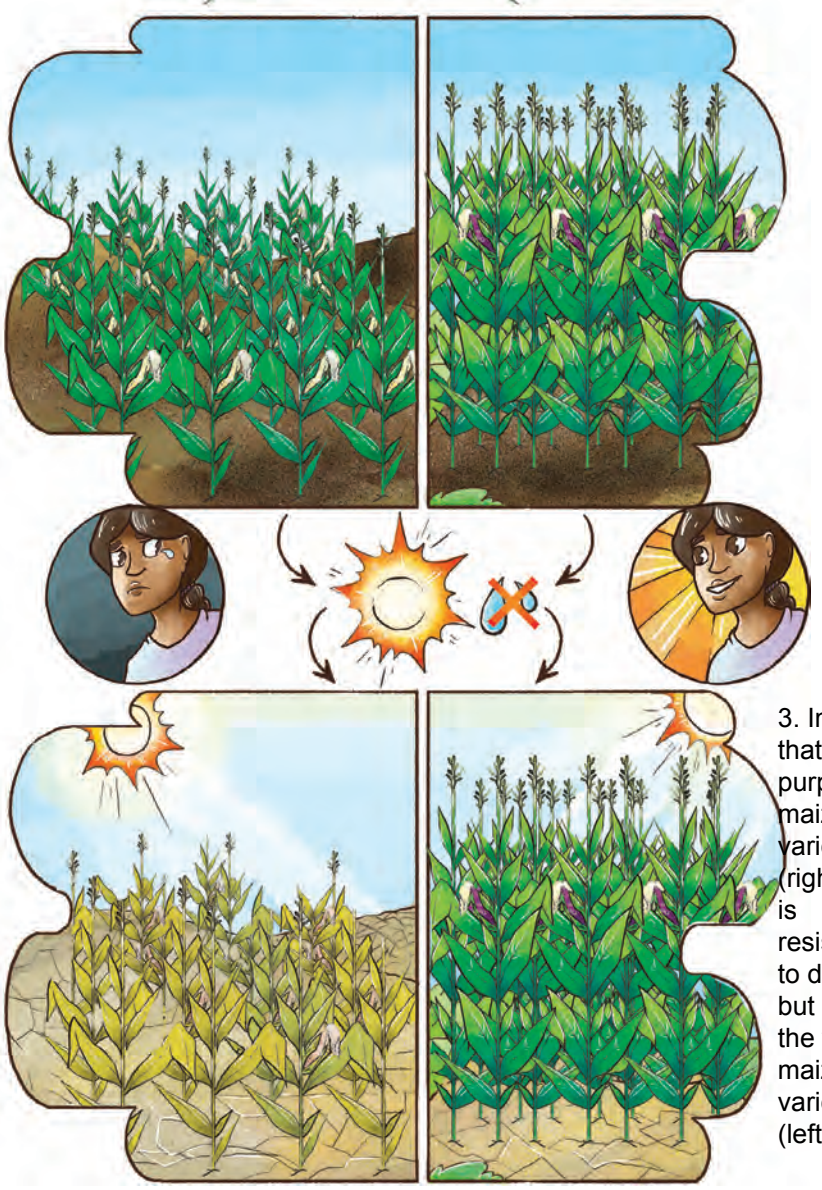


Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 1).

1. Example: Imagine two varieties of maize (white, purple)

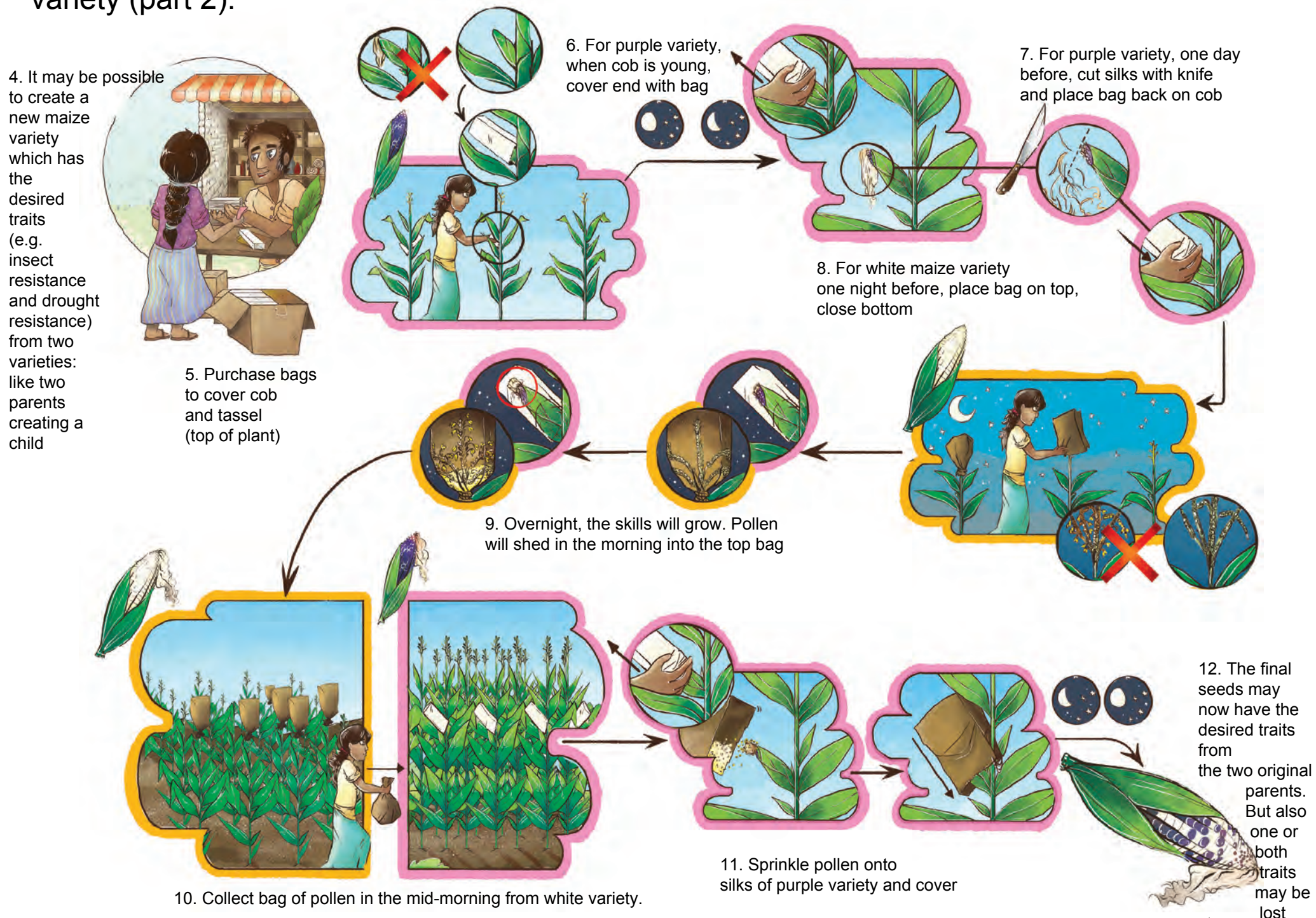


2. Imagine the the white maize variety (left) is tolerant to insects but not the purple maize variety (right)



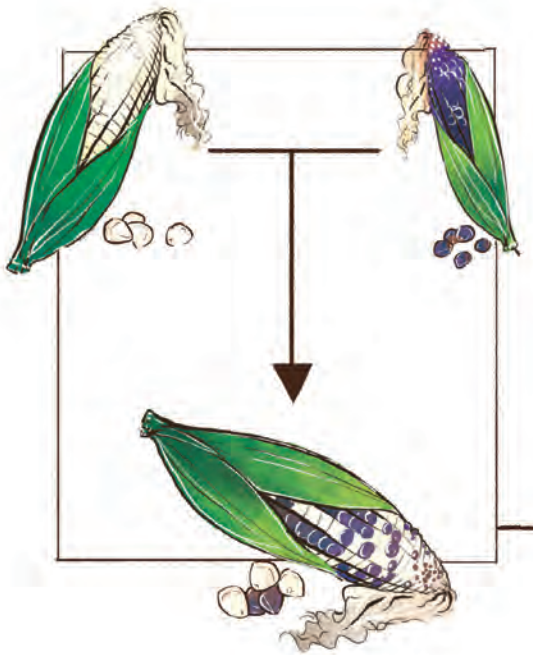
3. Imagine that the purple maize variety (right) is resistant to drought but not the white maize variety (left)

Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 2).

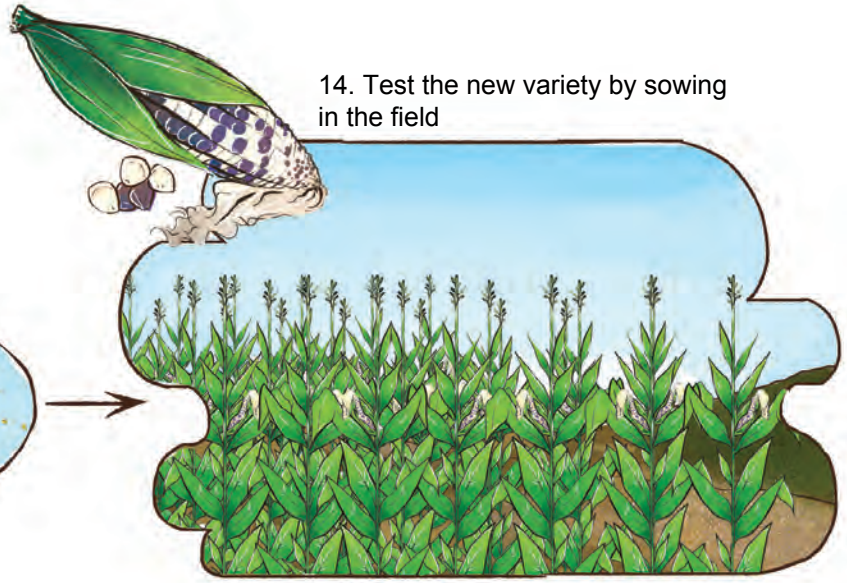


Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 3).

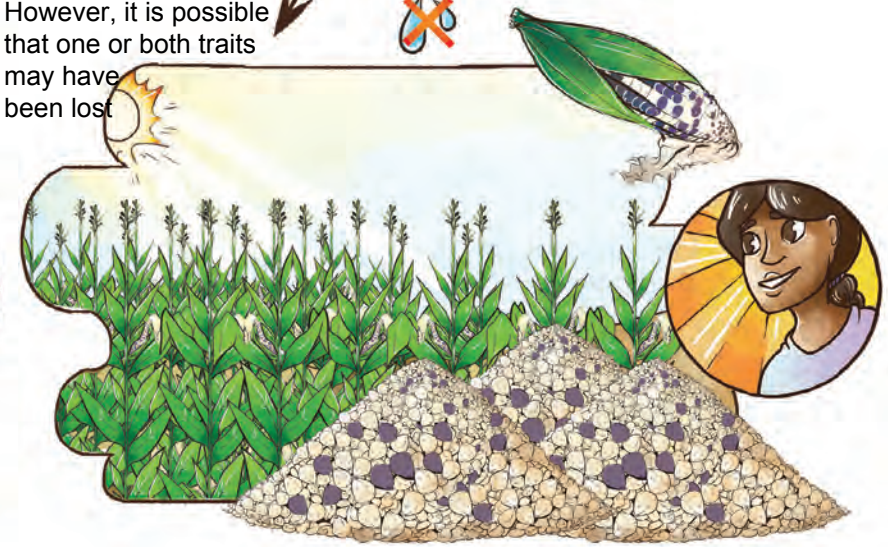
13. To review, as an example, the white maize variety (resistant to insect) and purple maize variety (resistant to drought) were used to create a new child with the hope that the child would have both good traits.



14. Test the new variety by sowing in the field



15. Observe whether the new variety is resistant to both insects and drought resulting in high yield. However, it is possible that one or both traits may have been lost



Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 1)

1. Example: Imagine two varieties of maize (white, purple)

2. Imagine that the white maize variety (left) is more tolerant to insects while variety (right) is more tolerant to drought

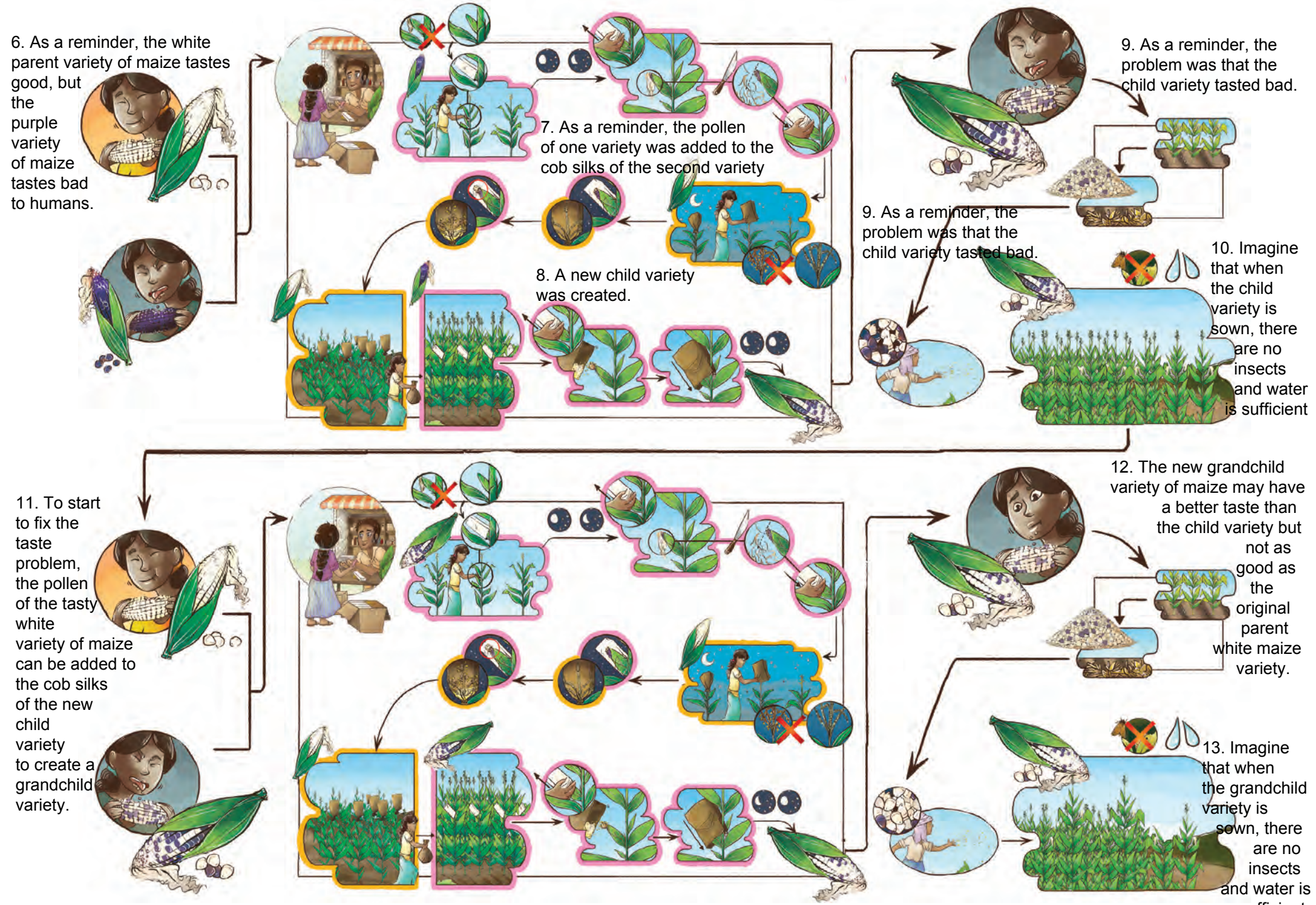
3. As described earlier, add the pollen of one variety to the cob silks of the second variety to create a new child with the hope that the child variety would have both good traits.

4. As described earlier, it is hoped that the new variety will be resistant to both insects and drought resulting in high yield

5. However, there may be a problem: the original white variety parent may have tasted good, while the original purple parent variety may have tasted bad (but was preferred by chickens). The problem is that the new high-yielding child variety may taste bad to humans. To fix the problem, multiple generations of adding pollen to ear silks will be required (next page).

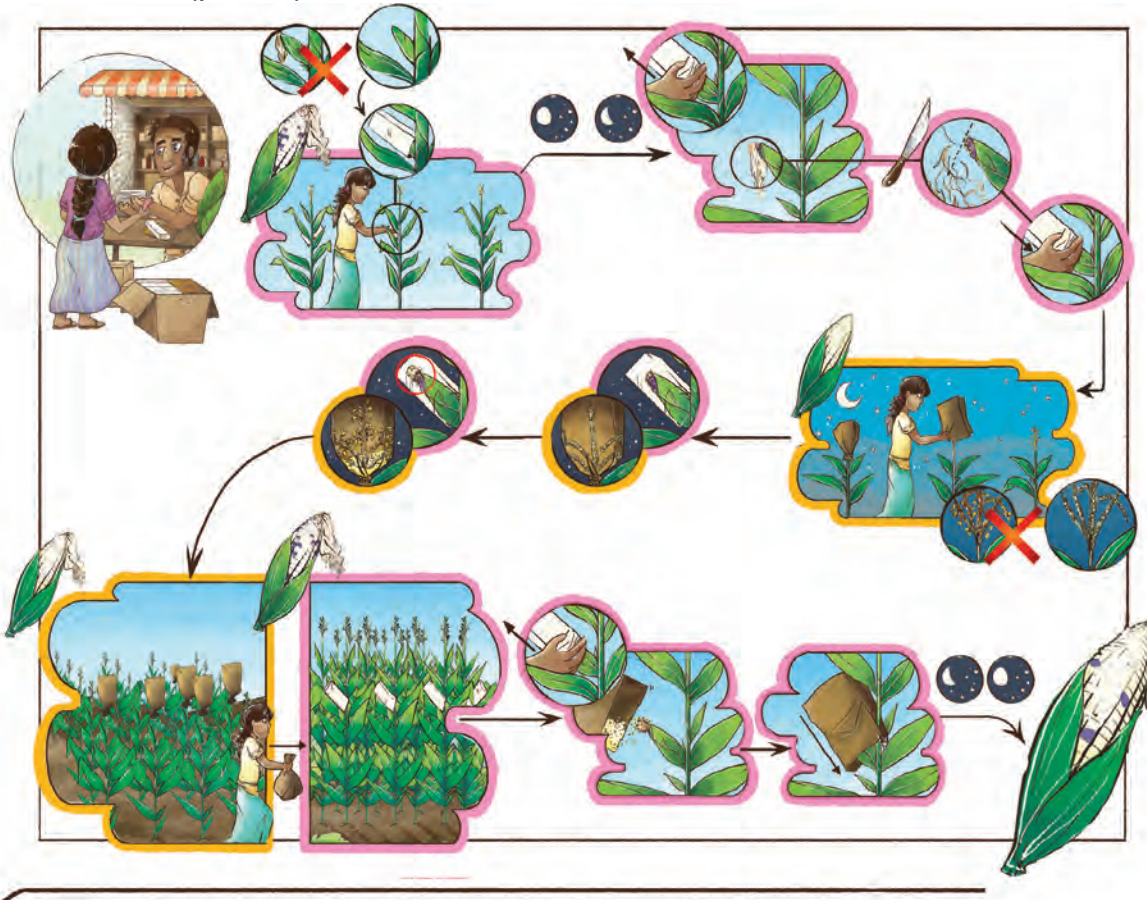
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 2)



Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 3)

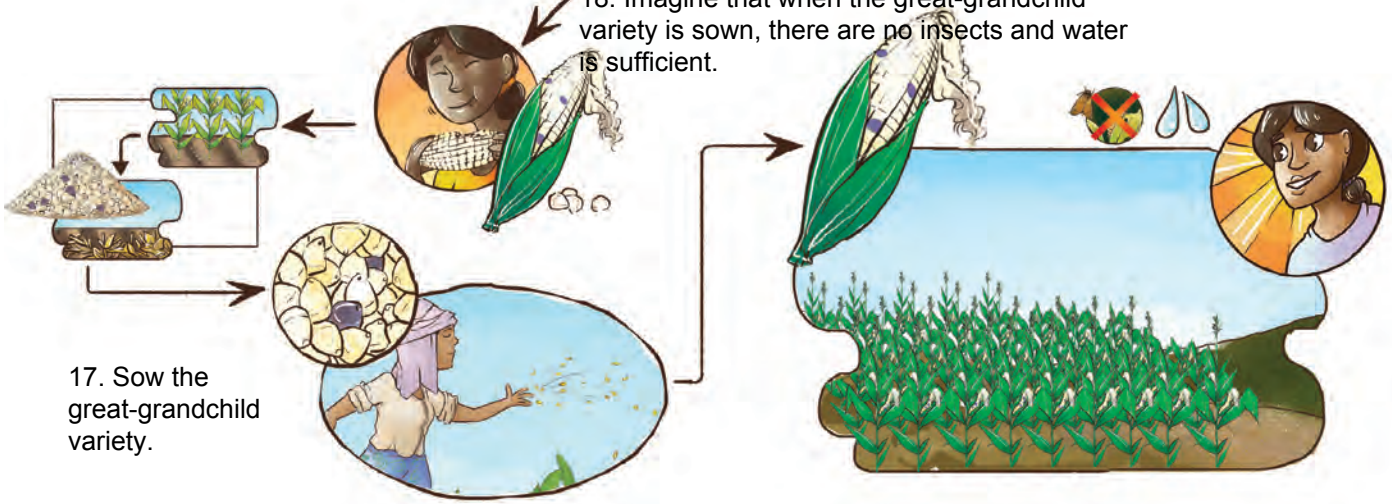
14. To continue to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety.



15. The new great grandchild variety will more resemble the originial white parent variety

16. The great-grandchild variety of maize is now tasty.

18. Imagine that when the great-grandchild variety is sown, there are no insects and water is sufficient.



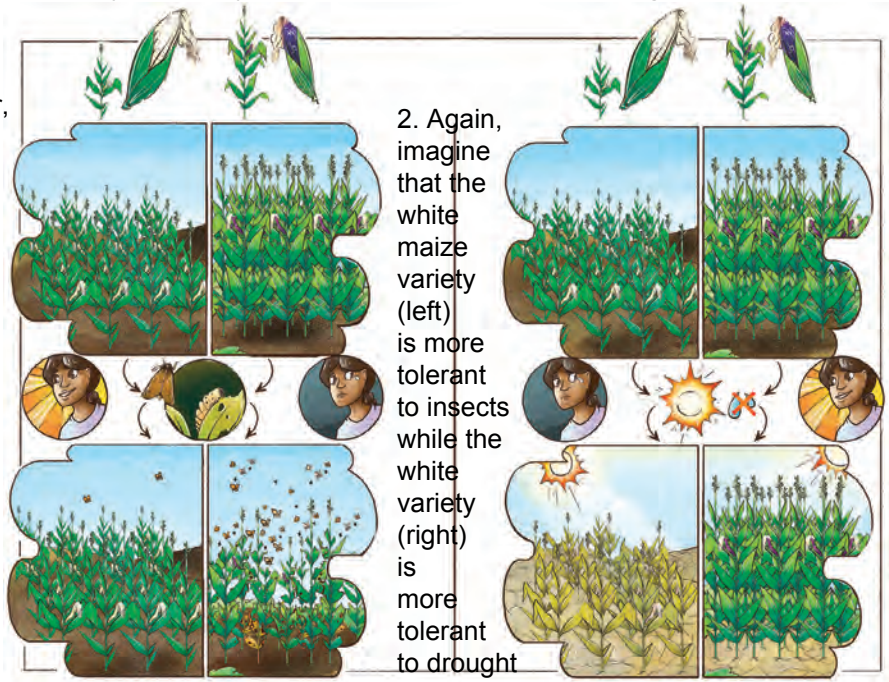
19. It is not clear whether the great-grandchild variety has kept its resistance to both insects and drought.

17. Sow the great-grandchild variety.

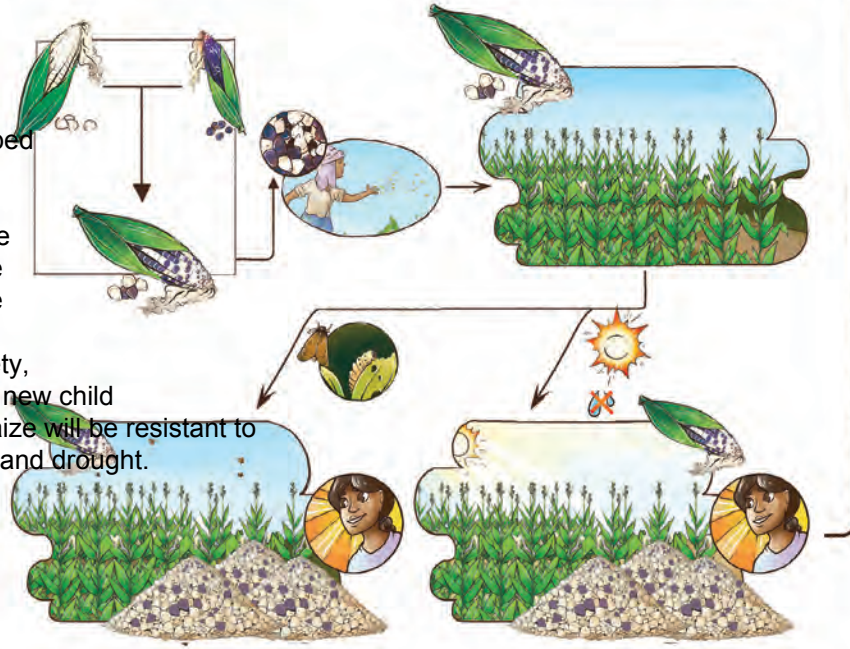
Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 1)

1. As a reminder, imagine two varieties of maize (white, purple)

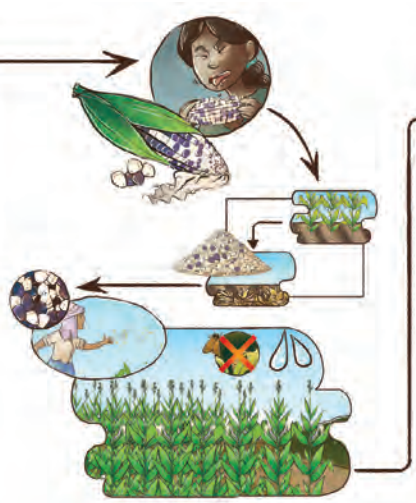
2. Again, imagine that the white maize variety (left) is more tolerant to insects while the white variety (right) is more tolerant to drought



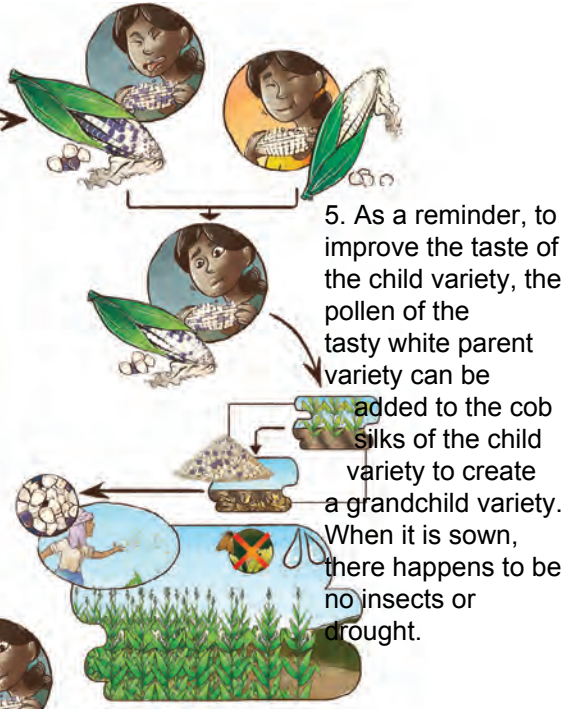
3. As described earlier, it is hoped that by adding the pollen of one variety to the silks of the second variety, the resulting new child variety of maize will be resistant to both insects and drought.



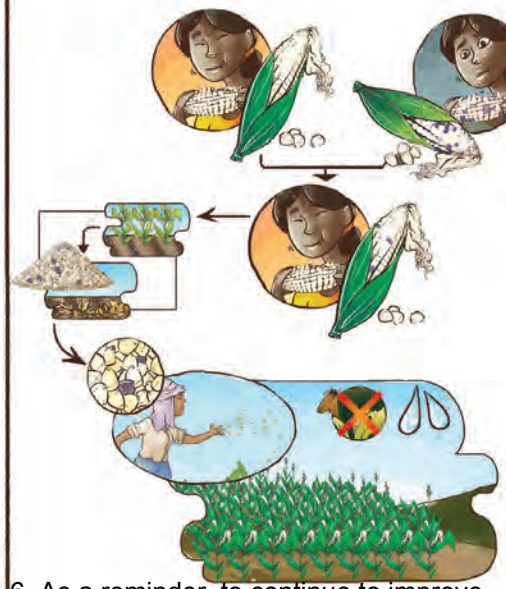
4. As a reminder, the child variety tastes bad. When it is sown, there happens to be no insects or drought.



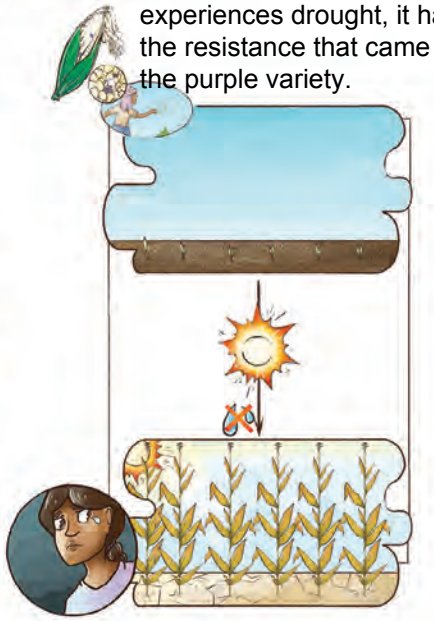
5. As a reminder, to improve the taste of the child variety, the pollen of the tasty white parent variety can be added to the cob silks of the child variety to create a grandchild variety. When it is sown, there happens to be no insects or drought.



6. As a reminder, to continue to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety to create a great-grandchild variety. When it is sown, there happens to be no insects or drought.



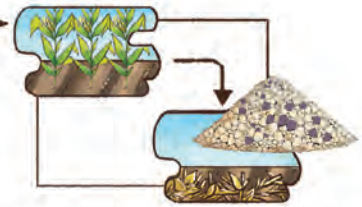
7. Problem: When the great-grandchild variety experiences drought, it has lost the resistance that came from the purple variety.



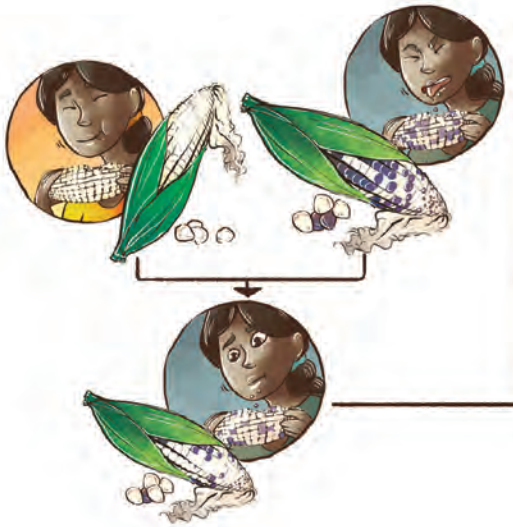
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator

Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 2)

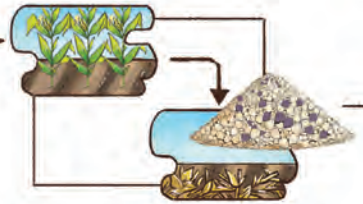
8. There is a method to maintain the benefits of both the white variety and purple variety, but at the same time have the variety resemble the most desired white variety that is tasty.

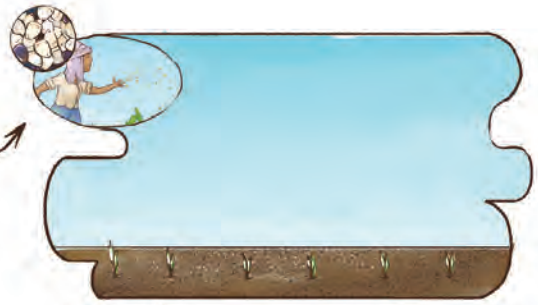


9. After creating the child variety from the white and purple parent maize varieties, sow the child variety.

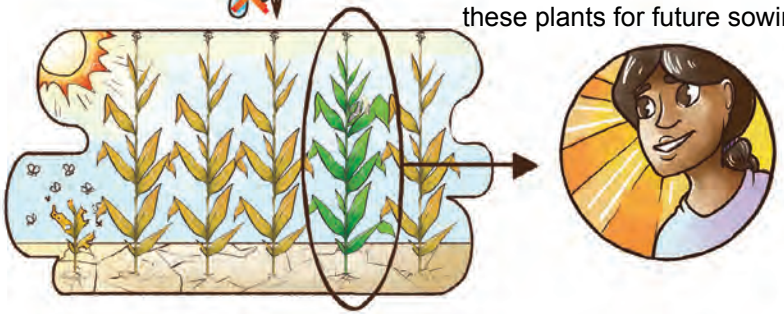


10. As before, to improve the taste of the child variety, the pollen of the tasty white parent variety can be added to the cob silks of the child variety to create a grandchild variety.



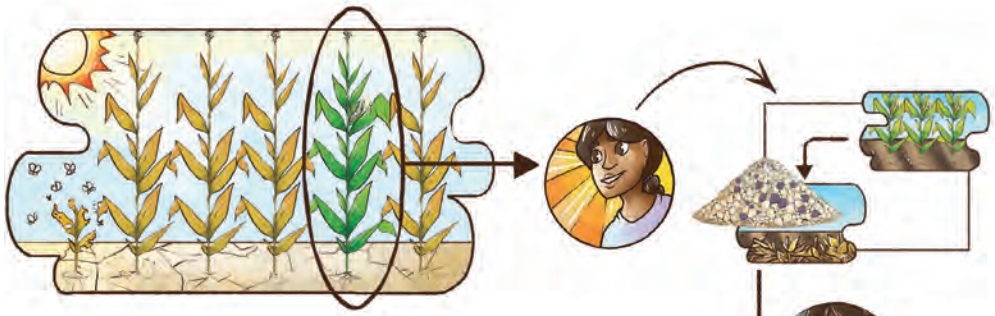


11. However, this time the grandchild variety should be exposed to drought (no irrigation) and the insects should not be prevented, in order to discover which plants ave kept resistance to both drought and insects. Select the seeds of only these plants for future sowing.



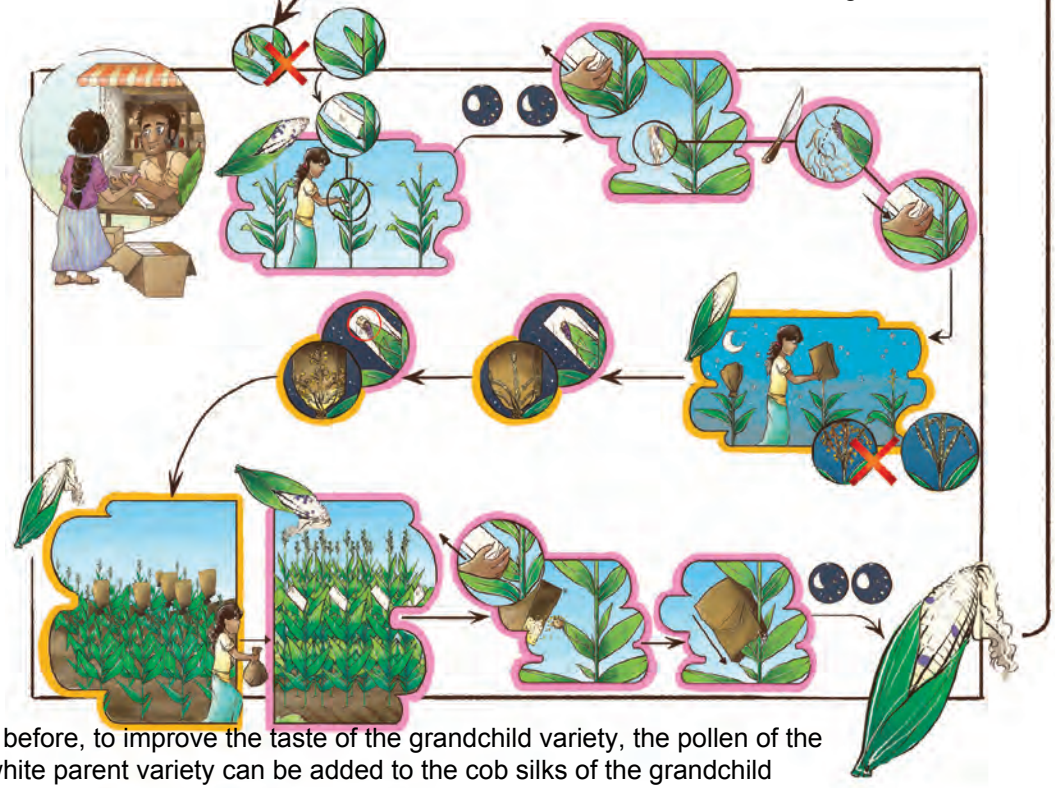
Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 3)

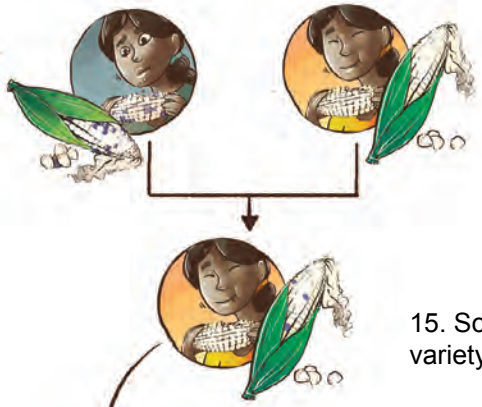


12. To repeat, sow the seeds of the grandchild plants which have resistance similar to both parent varieties, in this case to drought and insects.

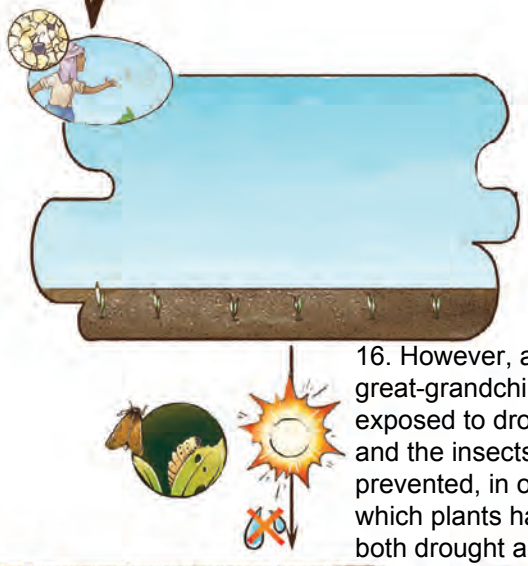
13. Problem is that the grandchild variety still does not taste good.



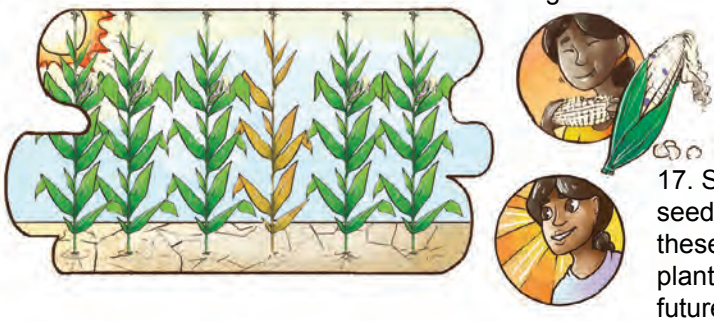
14. As before, to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety to create a great-grandchild variety.



15. Sow the great-grandchild variety..



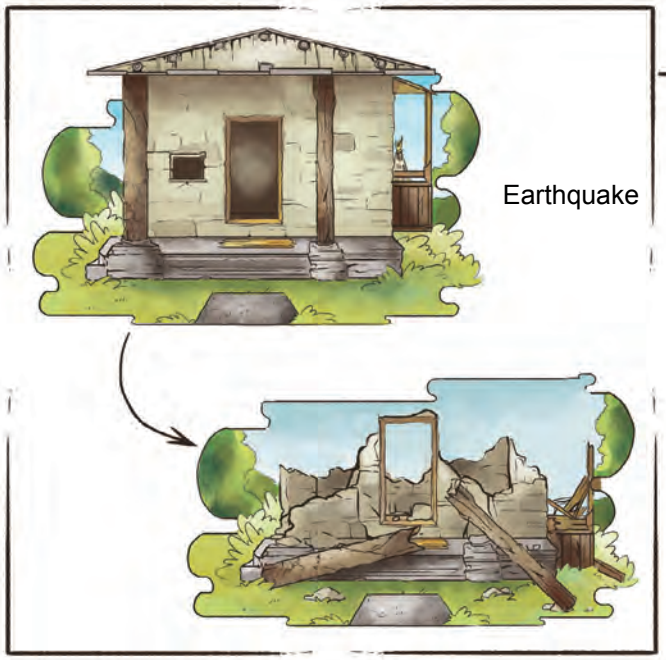
16. However, again this time the great-grandchild variety should be exposed to drought (no irrigation) and the insects should not be prevented, in order to discover which plants have kept resistance to both drought and insects.



17. Select the seeds of only these healthy plants for future sowing.

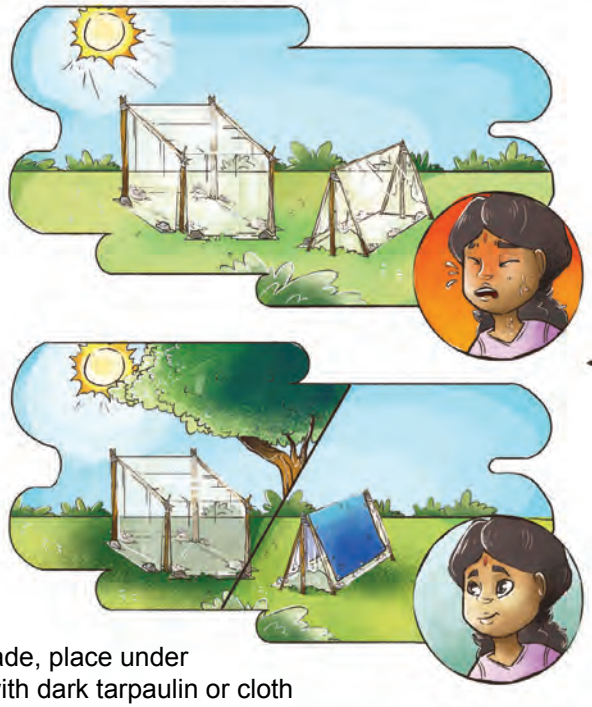
Chapter 13: **Disaster Relief**

Lesson: How to build shelter from a roll of tarpaulin or plastic sheets



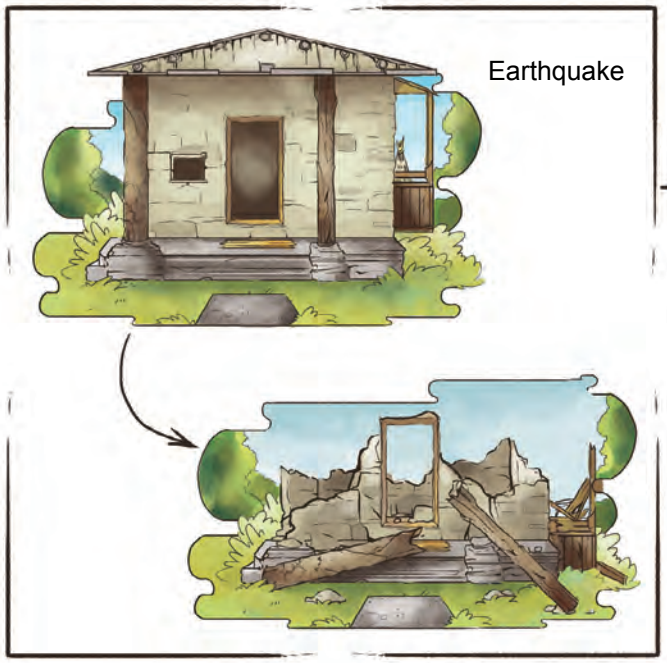
1. Wood frame tied with rope or duct tape (water proof)

2. Roll of tarpaulin or plastic



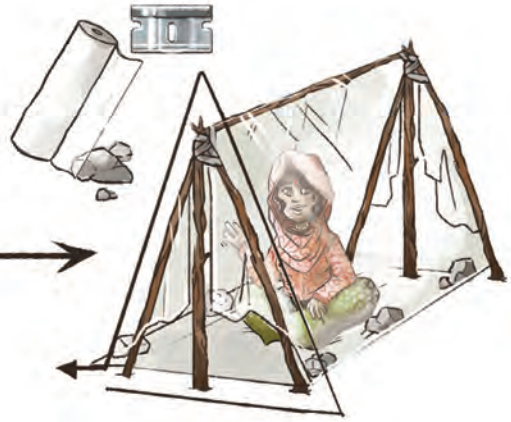
3. For shade, place under trees or with dark tarpaulin or cloth

Lesson: How to build shelter from a roll of tarpaulin or plastic sheets



1. Wood frame tied
with rope or duct tape (water proof)

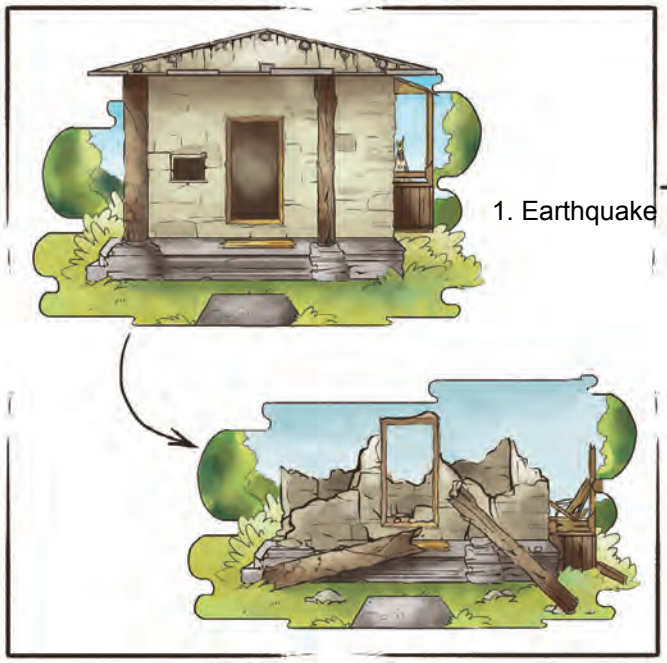
2. Roll of tarpaulin or plastic



3. Can use tree branch

4. For shade, place under trees or with dark tarpaulin or cloth.

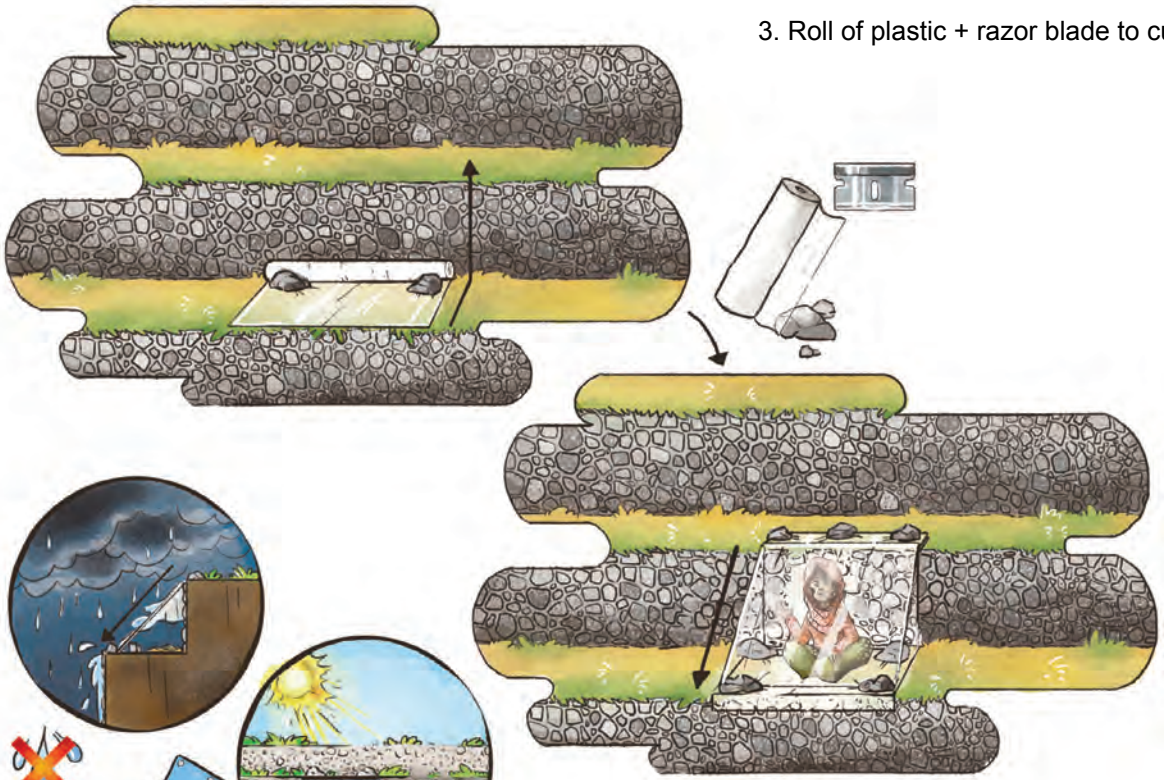
Lesson: How to build a shelter from a roll of tarpaulin or plastic sheets, rapidly, without using wood by using the terrace wall



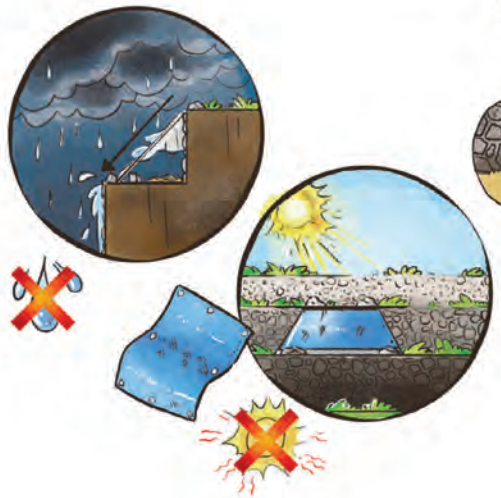
1. Earthquake

2. Unroll plastic on terrace

3. Roll of plastic + razor blade to cut

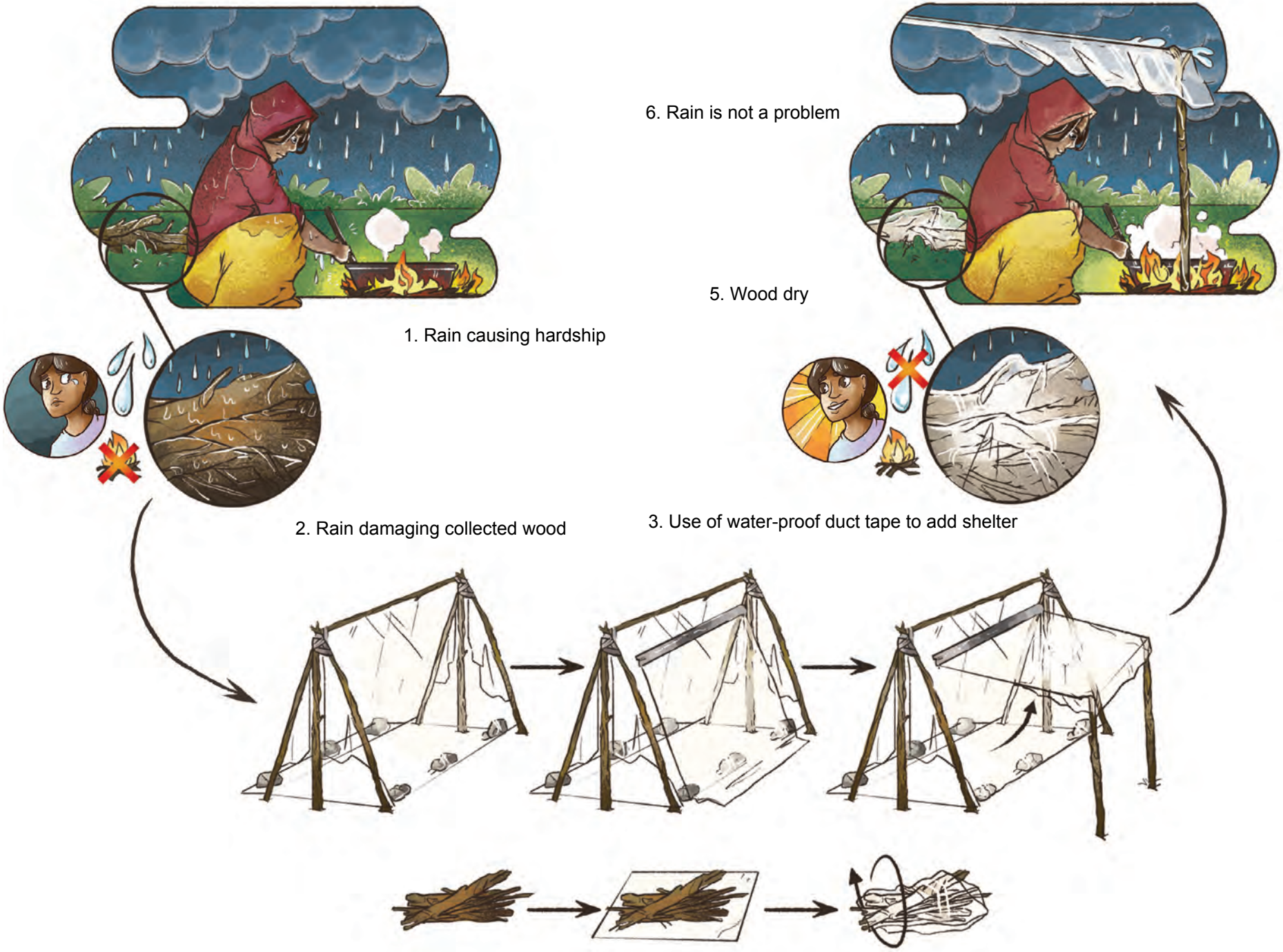


4. Place in area with low water flow



5. For shade, cover with dark tarpaulin or dark cloth

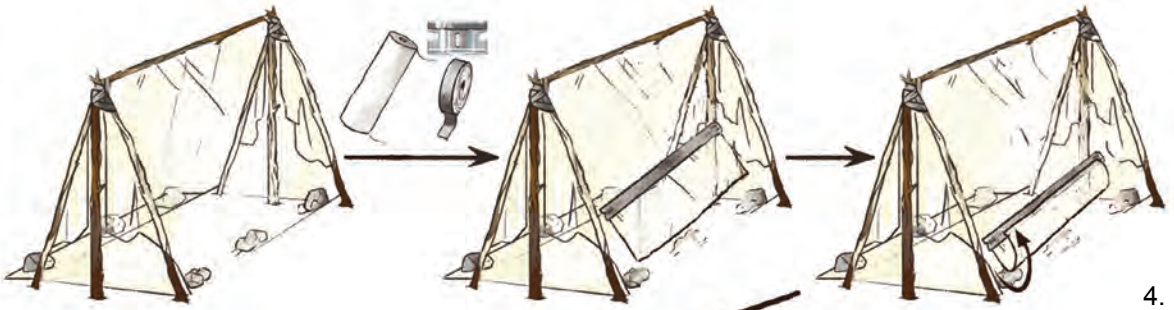
Lesson: Roll of plastic or tarpaulin can be used to create a shelter for cooking and to keep collected wood dry



Lesson: A roll of plastic or tarpaulin may be used to collect clean drinking water from rainfall (water harvesting)

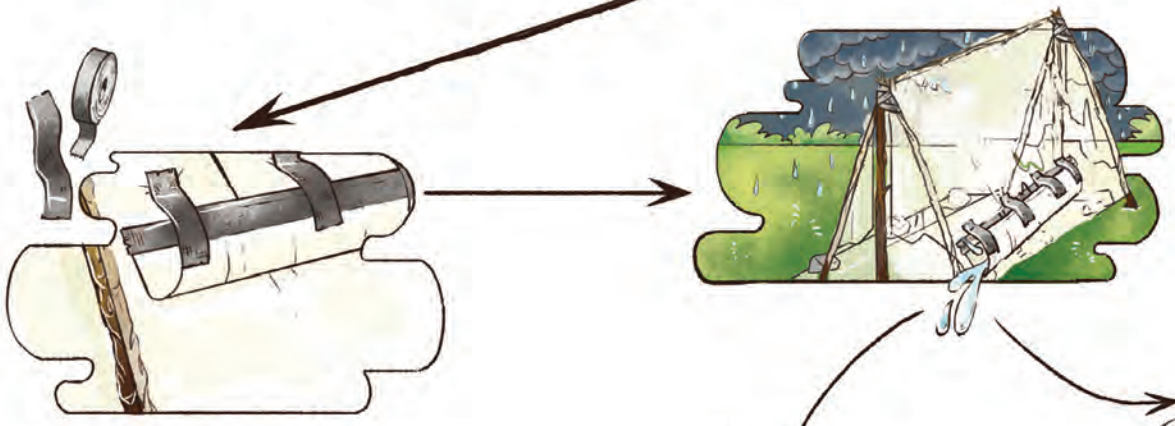
1. Thirsty

2. Roll of plastic, razor blade and water-proof duct tape



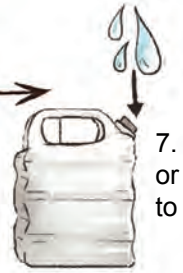
3. Tape plastic at a sloping angle

4. Fold up

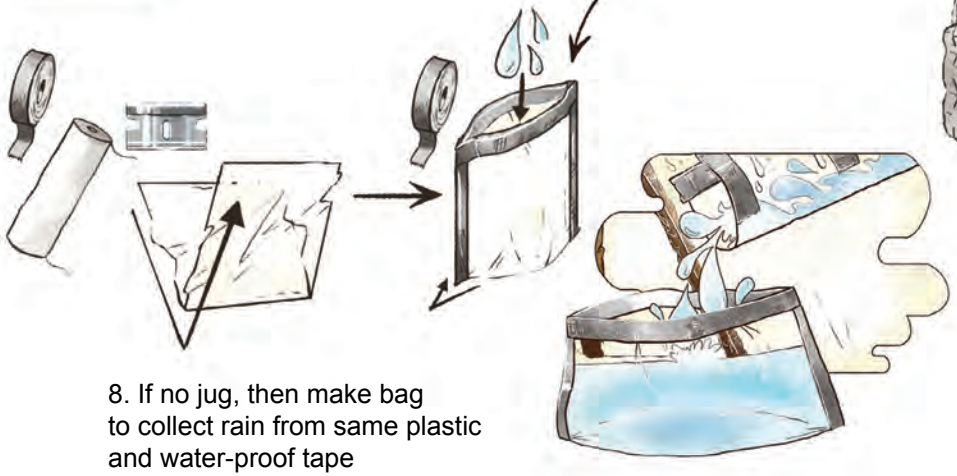


5. Add tape

6. Collect rain

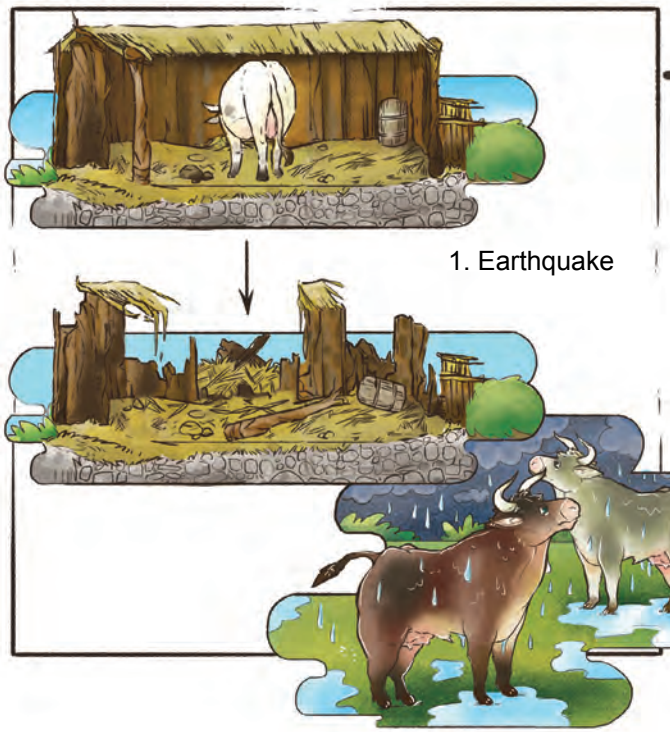


7. Use jug or container to collect rain



8. If no jug, then make bag to collect rain from same plastic and water-proof tape

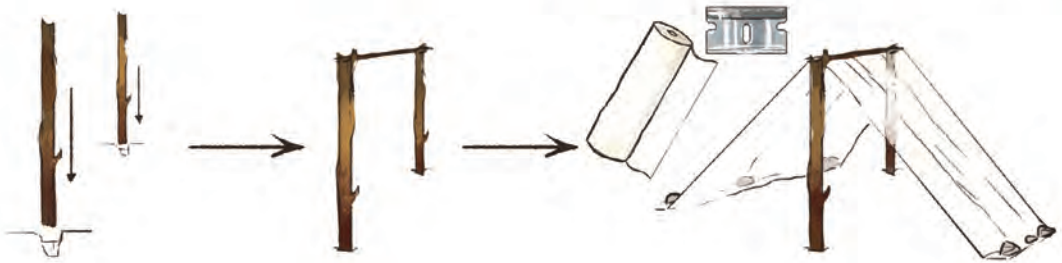
Lesson: A shelter can be made for animals using a roll of plastic or tarpaulin



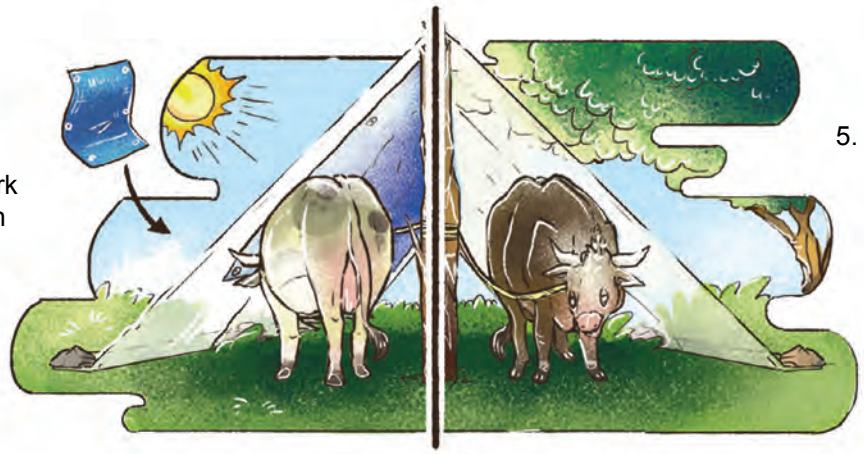
1. Earthquake

2. Roll of plastic or tarpaulin

3. Razor blade for cutting



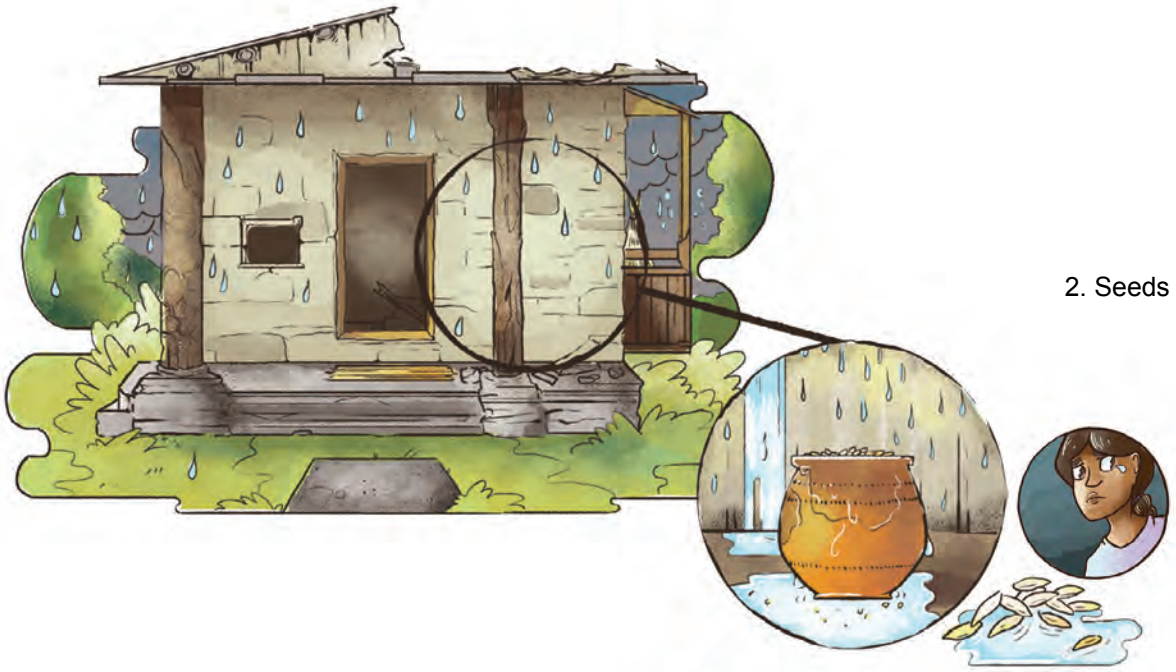
4. For shade, add dark tarpaulin or dark cloth



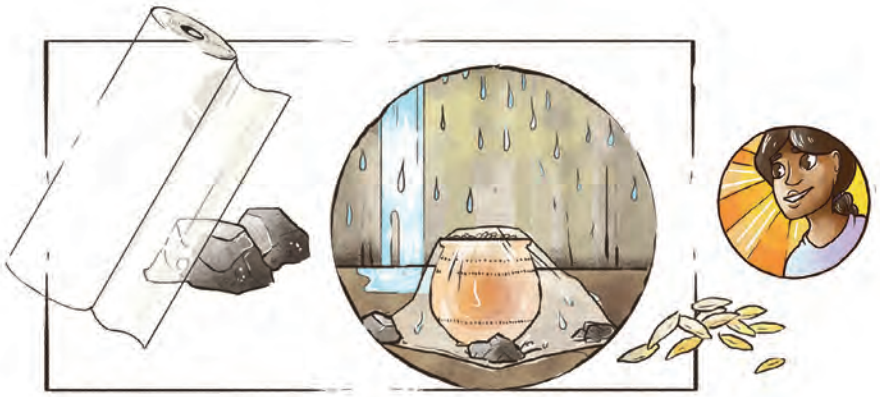
5. For shade, use trees

Lesson: A roll of plastic or tarpaulin, or a bag may be used to protect seeds or food from rainfall

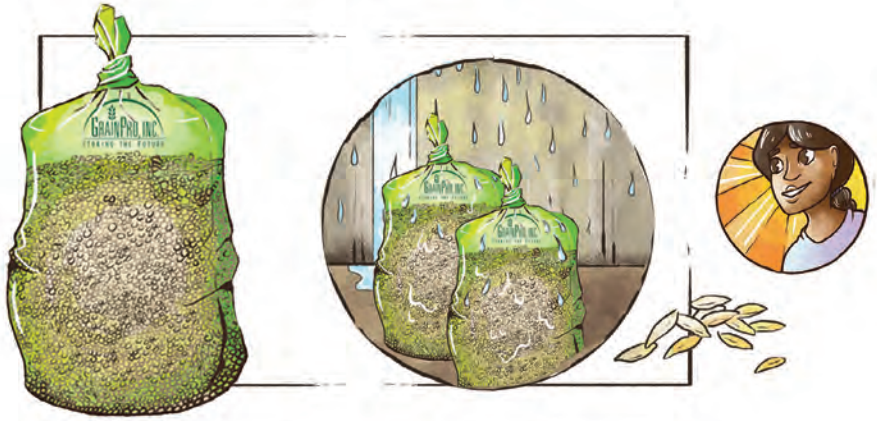
1. Earthquake causing damage to home or granary



2. Seeds will be damaged by rain



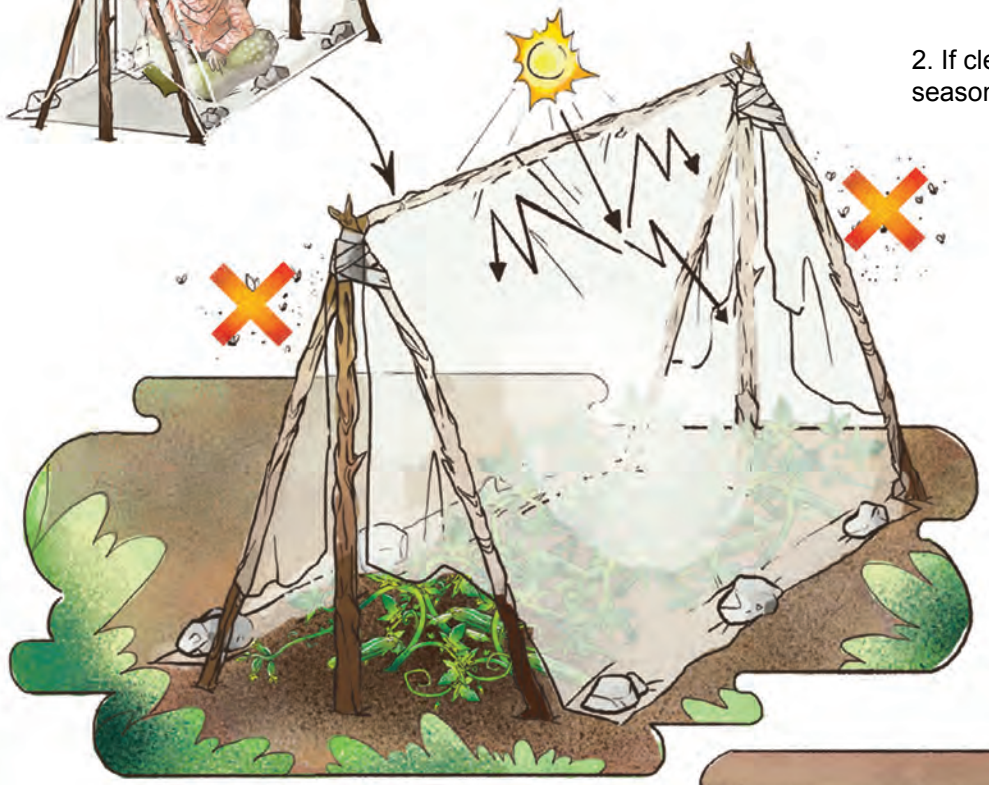
3. Roll of plastic or tarpaulin will protect seeds



4. Plastic bag will protect seeds from rain. A special bag from Grainpro will also protect seeds from insects and mold

Lesson: A tent shelter can be re-purposed later into a greenhouse or shade house for plants

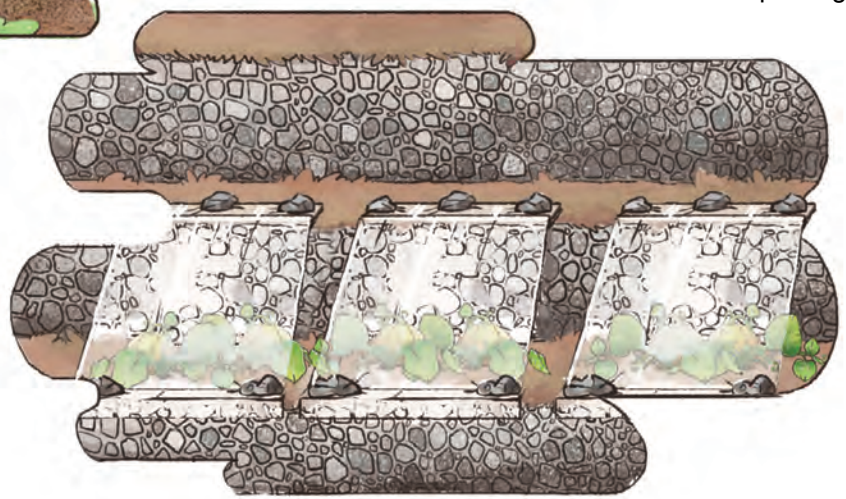
1. Tent



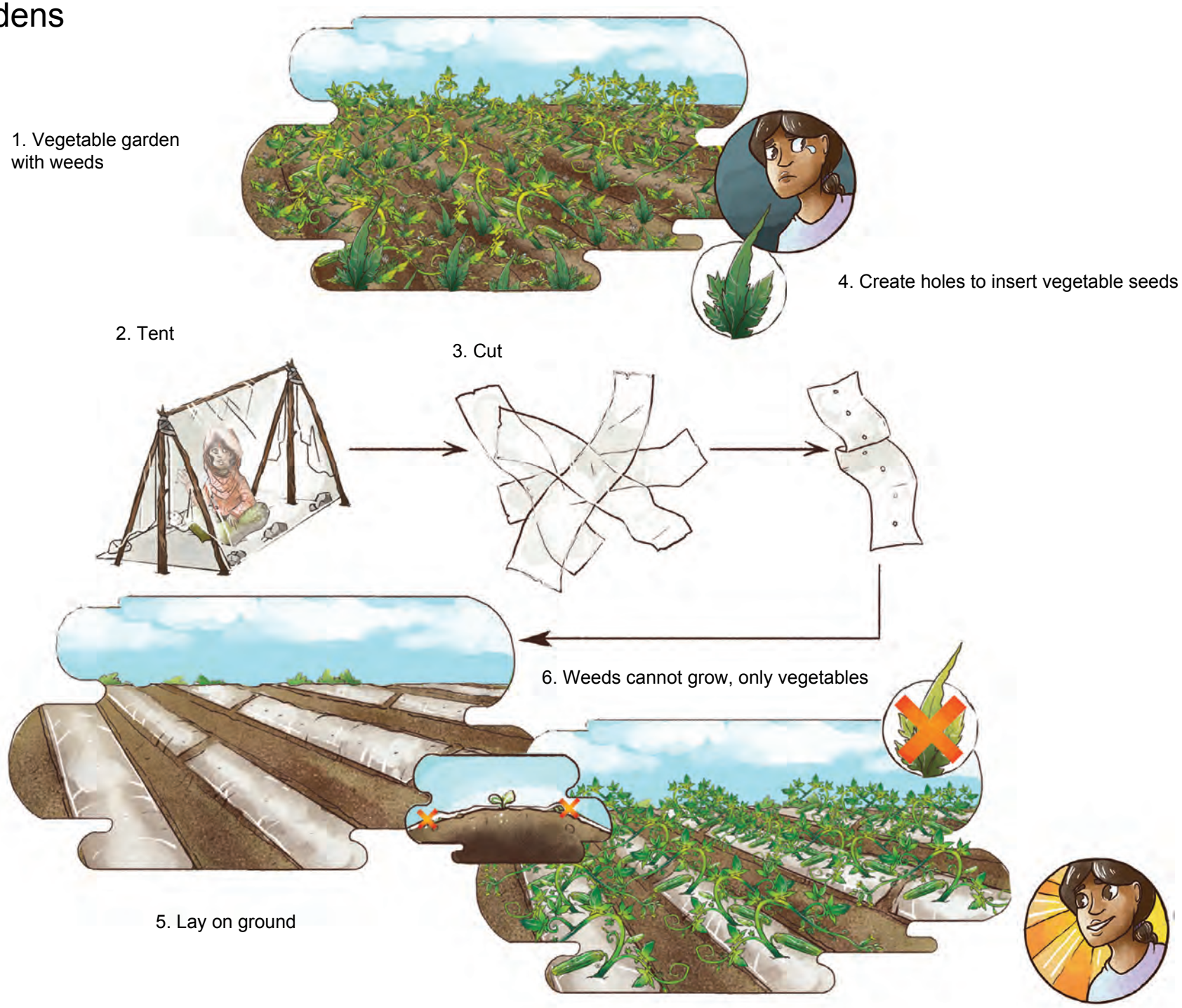
2. If clear plastic, then use as a greenhouse in the winter season, or to protect against insects.

3. If dark plastic, then open sides of tent and use as a shade house to assist young vegetable seedlings to grow

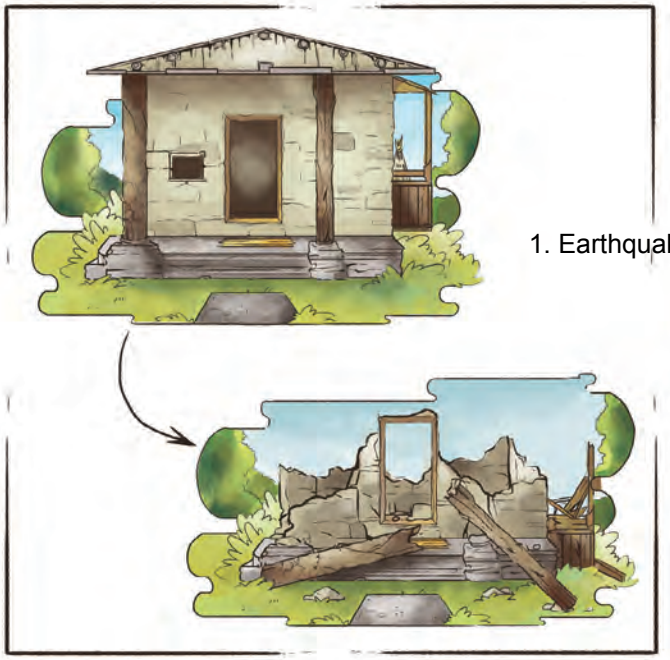
4. Example of greenhouse on terrace



Lesson: Tarpaulin or plastic used for tent shelters can be re-purposed to prevent weeds in home gardens



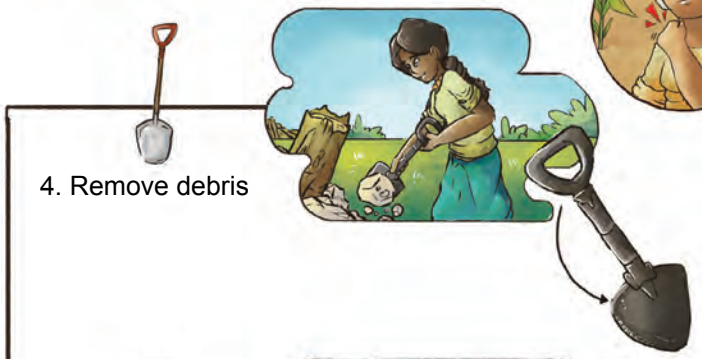
Lesson: A foldable shovel that is light-weight and multipurpose can be used to remove earthquake debris, but re-purposed later to help with farming



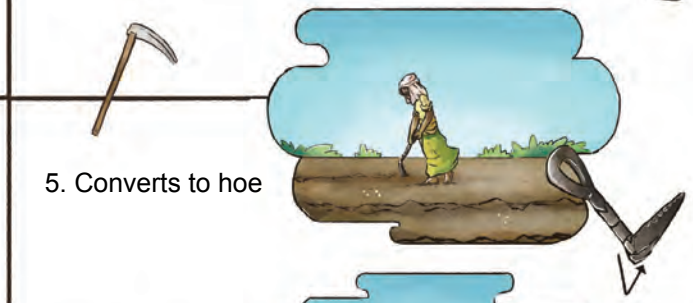
1. Earthquake

2. Removing debris by hand causes injury

3. Foldable shovel



4. Remove debris

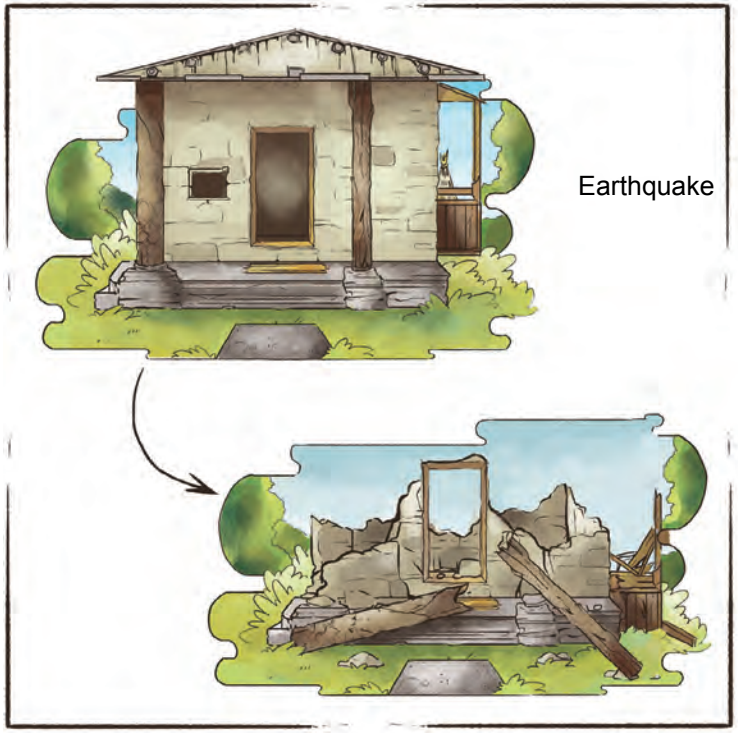


5. Converts to hoe

6. Converts to saw to cut wood

7. No injury

Lesson: Water-proof gloves can help to clean debris and later can be used for farming to protect hands



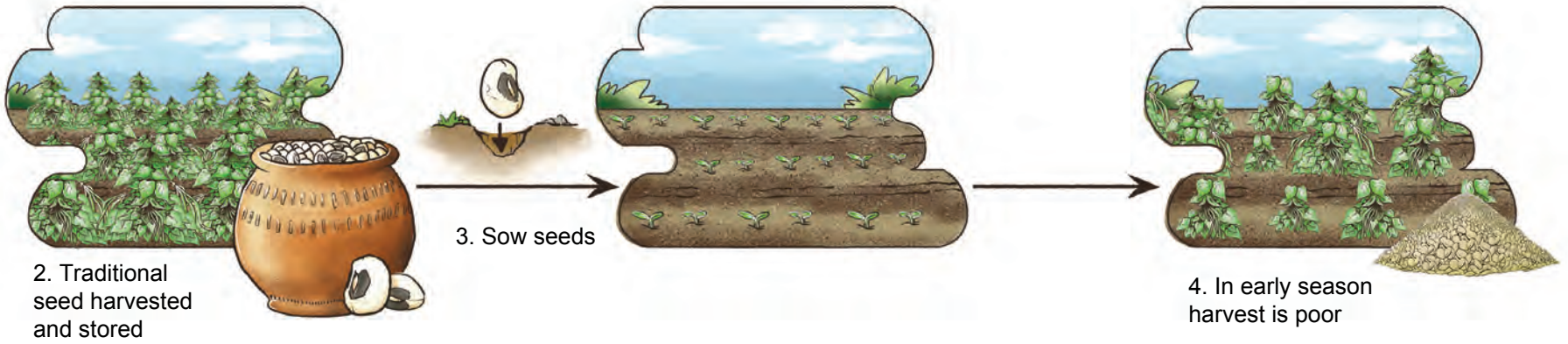
1. Picking debris with bare hands causes injury

2. Gloves protect hands

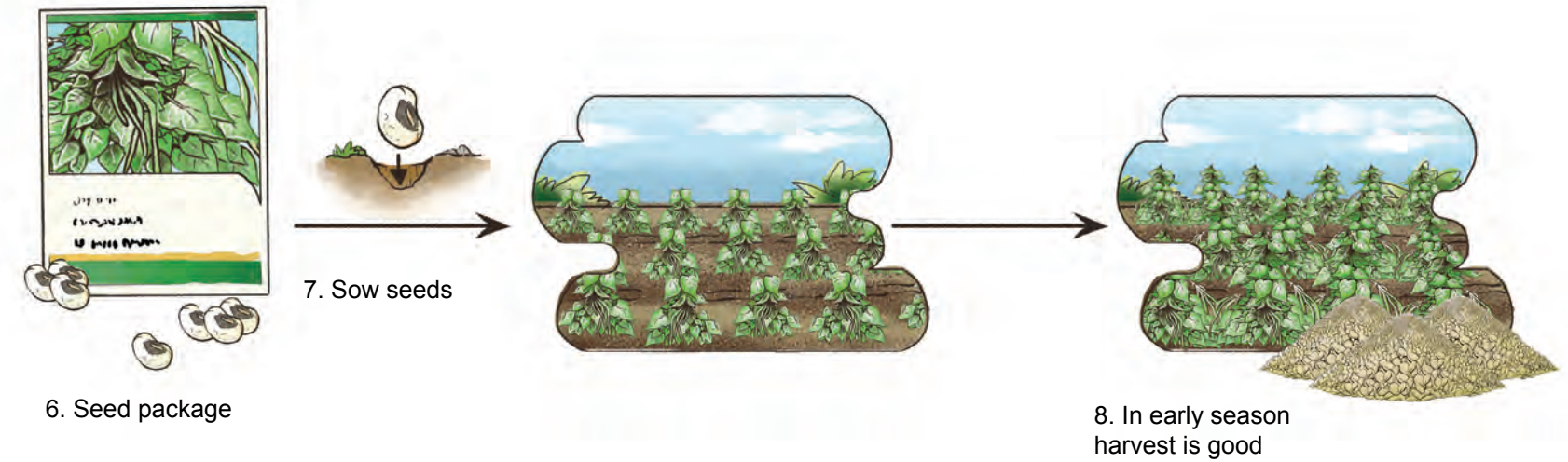
3. Re-use gloves during farming

Lesson: Seed package contains an early maturing variety to produce food early

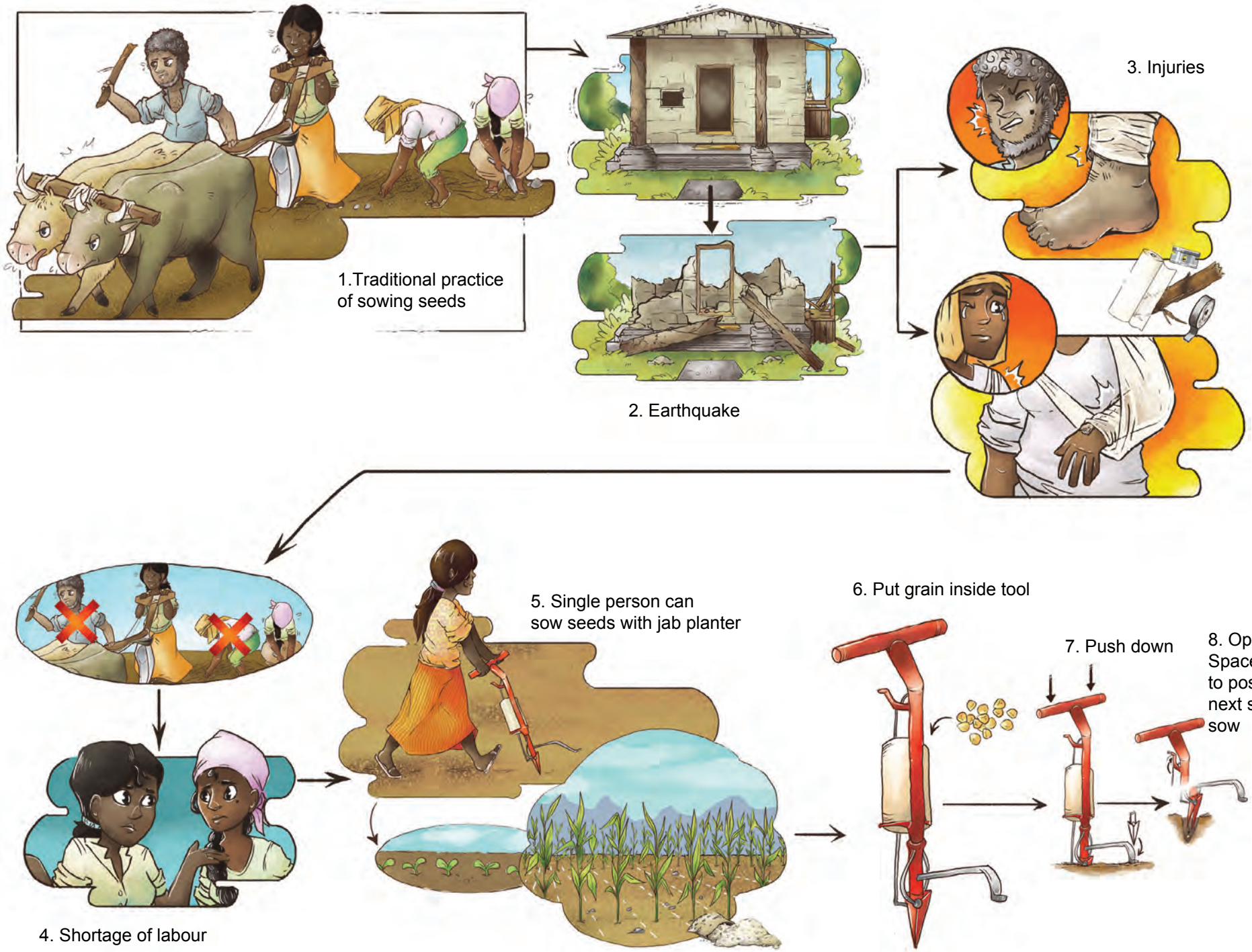
1.Traditional seed variety



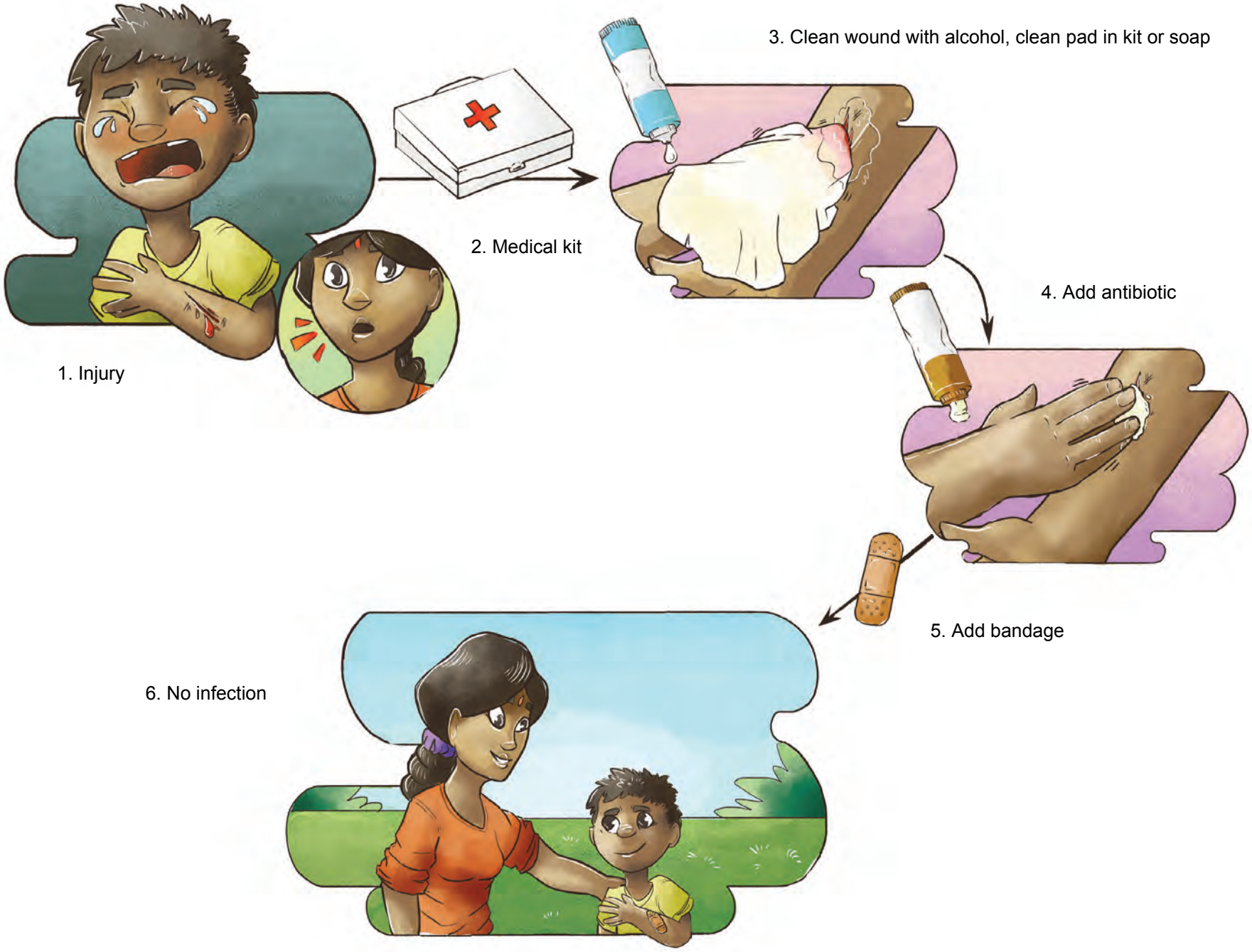
5. Early maturing seed variety



Lesson: A jab planter reduces labour required to sow seeds



Lesson: After a cut, clean wound, then apply antibiotic to the wound, before adding a bandage to prevent infection



Manish N. Raizada, Ph.D.; Lisa Smith, Illustrator
SAK Picture Book • Creative Commons

Bonus Chapter: **Alternate Versions**